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AIR POLLUTION SURVEY. REPORT 1. AIR POLLUTION EMISSIONS IN THE DELAWARE VALLEY FOR 1965

H. C. Wohlers, et al

Regional Conference of Elected Officials
Philadelphia, Pennsylvania

June 1968

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RCEO
regional conference
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AIR
POLLUTION
SURVEY
REPORT

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AIR POLLUTION EMISSIONS

THE DELAWARE VALLEY

HE ENVIRONMENTAL ENGINEERING AND SCIENCE PROGRAM
REXEL INSTITUTE OF TECHNOLOGY, PHILADELPHIA, PENNSYLVANIA

RCEO

The Regional Conference of Elected Officials, Inc. is a voluntary, non-profit corporation of chief elected officials of local general governments (counties and municipalities) in the eleven county tri-state Penjerdel Region (Philadelphia-Camden, Trenton and Wilmington metropolitan areas).

The chief elected official is the member. He represents his government and he may designate another elected official of the governing body as a permanent alternate. The entire membership comprises the Conference. The Board of Directors consists of county members, the five designated major city members, two members of other governments elected from each state and the secretary and the treasurer. The RCEO Council consists of all member governments of 25,000 population or more plus two other member governments elected from each county. All critical questions such as dues, annual budget and so forth must be approved by the Council and the Conference. This may be accomplished by mail ballot. All representatives have one vote.

RCEO provides a forum for the chief elected officials of the various municipalities to discuss common problems and seek common strategies.

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AIR POLLUTION EMISSIONS IN THE DELAWARE VALLEY FOR 1965

H. C. WOHLERS, Associate Professor Environmental Science
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ENVIRONMENTAL ENGINEERING AND SCIENCE PROGRAM

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RCEO
AIR POLLUTION
SURVEY REPORT

GENERAL PREFACE

The atmosphere is, by all odds, man's most vital natural resource. Until quite recently, we lived comfortably with the ambivalent views that (1) the atmosphere can be used freely for the disposal of the airborne waste products of an industrialized society, and (2) that people are, at all times, entitled to air in a form which will enable them to live cleanly, comfortably, and in good health.

With the recognition that we now dump more than 133 million tons of aerial garbage into the U. S. atmosphere each year, and recent grim reminders of possible mass death afforded us by stagnant, heavily polluted atmosphere over our metropolitan areas, that comfort no longer exists. As a society, it seems clear that we are irrevocably committed to the development of new public policy, new organizational and institutional forms, and new technology which will insure a safe, healthy atmosphere.

the problem of

As unique evidence of that commitment, the Regional Conference of Elected Officials, Inc., (RCEO) has sponsored this study of the air pollution problem in the vast 11-county, tri-state region centered on Philadelphia. Part of the unique commitment to action is reflected in the financing arrangement for the study which involved a grant from the United States Public Health Service and the individual contributions of local units of government throughout the region. Further, this study effort provides new evidence that autonomous local units of government can join together in a cooperative venture to solve a common problem.

is studied in

the

The Region, for purposes of this study, encompasses the three metropolitan areas of Philadelphia-Camden, Trenton, and Wilmington, located in Pennsylvania, New Jersey and Delaware respectively. The area extends generally along the Delaware River from Mercer County, New Jersey, in the north to New Castle County, Delaware, in the south. This area, about 4,545 square miles in extent and with a present population of over 5 million, forms an approximate rectangle 80 by 57 miles in size and oriented with the major axis NE-SW.

Exceeded only by the area centering on New York City, this Philadelphia tri-state region has the most complex governmental structure of any urban area in the United States, consisting of 11 counties and 377 municipalities in parts of three states.

The pattern of urban development and industrial concentrations makes it reasonable to consider the Region a discrete area for investigation of air pollution control problems. The urbanized portion of the Region is, in the main, concentrated along both sides of the Delaware River and rarely extends more than a dozen miles inland. A high percentage of the Region's 9,000 highly diversified manufacturing establishments are located within this band along the River.

The end objective of the study is to define the requirements for the development of an air resource management and control system appropriate to the solution of the

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problem in the 11-county tri-state Region, and, specifically, to determine the governmental machinery and arrangements through which such a system can operate effectively. The design of a viable management and control system for air pollution must be based on: (1) knowledge of the technical characteristics and dimensions of the problem in terms of the real and potential impact; (2) careful exploration and definition of major approaches in developing the technical methods and procedures to resolve the problem; and (3) construction of the optimal governmental framework, legal base, and administrative procedures through which the functional resolution of the problem can be implemented.

In keeping with this basic approach, the study was organized into three areas: 1) Emissions Survey, 2) Meteorological Analysis, and 3) Governmental Aspects. A separate component technical Report, each with a separate summary, has been prepared under each of these titles. The Emissions Survey was performed by Environmental Engineering and Science, Drexel Institute of Technology; The Meteorological Analysis was performed by C. W. Thornthwaite Associates Laboratory of Climatology; and the Governmental Aspects were analyzed by the Fels Institute of Local and State Government, University of Pennsylvania. A Report containing a review of study findings and implementation of study proposals accepted by RCEO will be prepared by the RCEO staff under Executive Director Chester A. Kunz, Rear Admiral, U. S. Navy, Retired.

The study operated under the general direction of the RCEO Air Pollution Committee with the Hon. John E. Babiarz, Mayor of Wilmington, Chairman.

The study benefited from the interest and efforts of the Technical Advisory Committee which was formed to provide general guidance and counsel at specific intervals. Committee members, representing the Air Pollution control agencies of the three states and the City of Philadelphia, were: Victor Sussman and Frank Willard, Jr., for Pennsylvania; William Munroe and Martin Sanvito, for New Jersey; John C. Bryson and James T. Wilburn, for Delaware; Arthur Wallach and Larry Himmelstein, for Philadelphia.

It should be noted that the findings, conclusions, and recommendations of the technical reports are the sole responsibility of the respective contractors, and the acceptance of these findings and conclusions along with recommendations for implementation will be the responsibility of RCEO.

The study is indebted to the many public and private officials of governmental agencies, business organizations, and civic groups which have cooperated through their sustained interest and active assistance. The efforts of all these participants can best be rewarded by the adoption of a program to insure a safe, healthy atmosphere for all citizens of the Region.

Regional Conference of Elected Officials

June, 1968

AIR POLLUTION EMISSIONS IN THE DELAWARE VALLEY FOR 1965

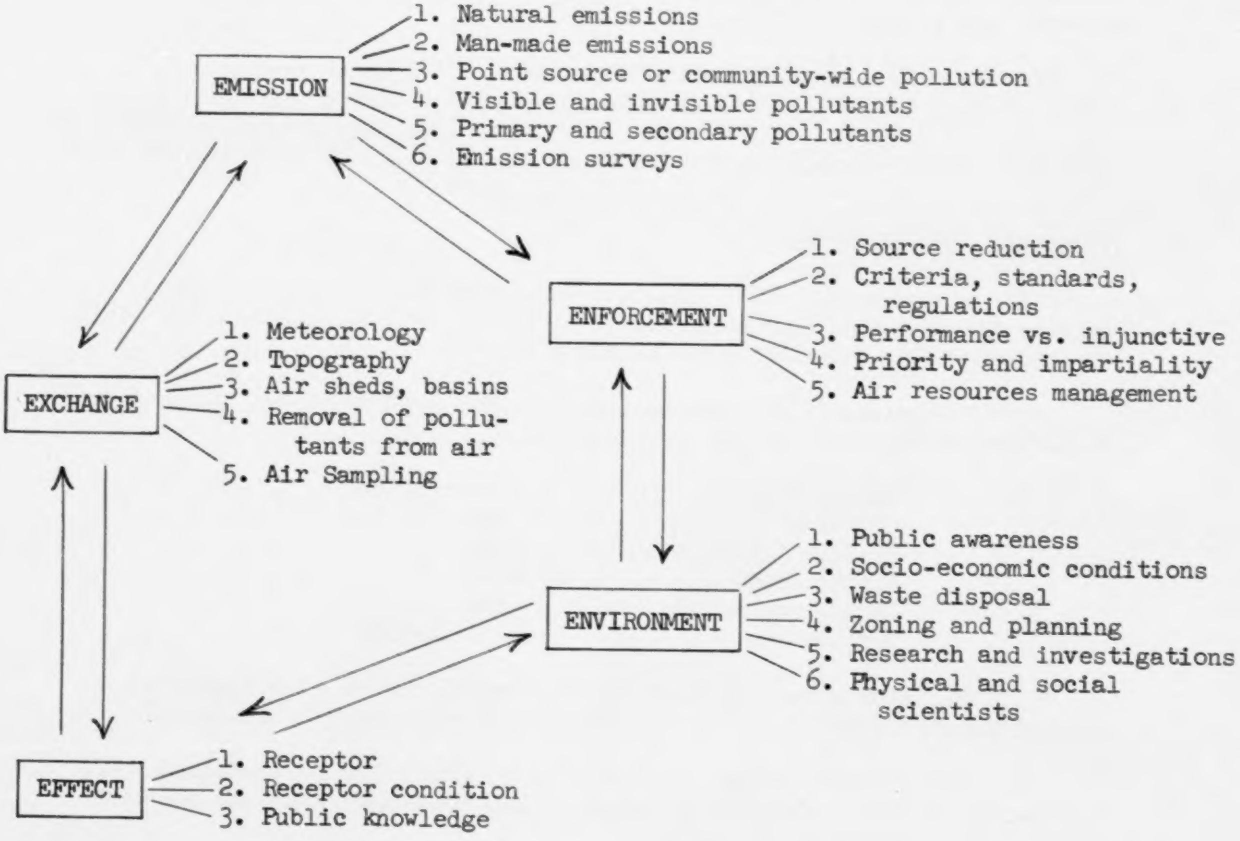
SUMMARY REPORT

I. INTRODUCTION

Air pollution, although an extremely complicated subject, may be considered a composite of the following facets: emission, exchange, effect, environment, and enforcement. Obviously, in order to have an air pollution problem, air pollutants must be emitted. Once the pollutants are discharged into the air, they are carried by or exchanged with air currents from the point of origin to the location where they affect humans, animals, vegetation, or material objects. A murky pollution filled atmosphere adversely affects the environment of all urban people. Finally, enforcement either on a voluntary or on a legal basis is necessary to prevent pollutants from entering the air. The interrelation between these 5 "E's" of air pollution is shown in Figure 1.

Figure 1

The Blending of the 5 "E's"
Spells-out Air Resource Management


EMISSION
1. Natural emissions
2. Man-made emissions
3. Point source or community-wide pollution
4. Visible and invisible pollutants
5. Primary and secondary pollutants
6. Emission surveys
ENFORCEMENT
1. Source reduction
2. Criteria, standards, regulations
3. Performance vs. injunctive
4. Priority and impartiality
5. Air resources management
EXCHANGE
1. Meteorology
2. Topography
3. Air sheds, basins
4. Removal of pollutants from air
5. Air Sampling
ENVIRONMENT
1. Public awareness
2. Socio-economic conditions
3. Waste disposal
4. Zoning and planning
5. Research and investigations
6. Physical and social scientists
EFFECT
1. Receptor
2. Receptor condition
3. Public knowledge

The weight of air pollutants released in an area, on a time basis, is known as an emission inventory or a source emission inventory. The emission inventory is a major tool to achieve a desired air quality. Once the discharge rates and sources of pollution are known, steps toward control may be undertaken. An updated yearly source emission inventory then becomes a realistic method of determining the progress of the community air pollution control effort.

The Environmental Engineering and Science Program at Drexel Institute of Technology undertook an emission survey to determine the weight of air pollutants discharged in the 11- county, tri-state region of Pennsylvania, New Jersey and Delaware (Figure 2). This survey, supported by local, federal, and Drexel funds, investigated all sources of air pollution - - - public, industrial, commercial and institutional - - within the Delaware Valley for 1965. Since the survey was initiated in the fall of 1966, the calendar year 1965 was the latest complete year for which data were available.

The procedures used to collect emission inventory data have been designed to obtain a maximum of information within the one year duration of the study. The major source categories that were investigated included: Transportation; domestic fuel burning; commercial, institutional and governmental heating; electrical power generation; industrial fuel burning and process emissions, and refuse disposal. Six classifications of air pollutants were considered: oxides of sulfur, oxides of nitrogen, organic compounds, carbon monoxide, benzo (a) pyrene*, and particulate matter.

This report presents the results of the source emission survey on a daily emission basis by months for each of the 11 counties within the Delaware Valley. The report is divided into two sections; the first section summarizes the data while the procedural details and calculations are summarized in the Appendices.

II SUMMARY OF FINDINGS

(1) During 1965, 15,175 tons of oxides of sulfur, oxides of nitrogen, organic compounds, carbon monoxide, benzopyrene, and particulate matter were discharged daily into the air in the Delaware Valley.

(2) The emission of 15,650 tons of pollutants discharged into the air daily in 1965 was divided into the following pollutants:

Oxides of Sulfur	2597 tons/day
Oxides of Nitrogen	992
Organic Compounds	2265
Carbon Monoxide	8663
Particulate Matter	658
Benzopyrene	98 lbs/day

(3) For each of the pollutants, the City and County of Philadelphia accounted for approximately 33% of the daily weight of compounds discharged.

(4) For oxides of sulfur, electrical power generation and industrial fuel burning and process emissions were responsible respectively for 48% and 44% of the daily discharge of 2755 tons.

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*Benzo (a) pyrene is hereafter written as benzopyrene.

(5) The daily emissions of oxides of nitrogen -992 tons- was evenly distributed between transportation (27%), electrical power generation (28%), and industrial operations (30%).

(6) Transportation and industrial operations accounted respectively for 58% and 30% of the daily weight of 2265 tons of organic compounds vented to the atmosphere.

(7) The greatest contributors to the 8663 tons of carbon monoxide emitted daily were transportation (70%) and industrial operations (28%).

(8) Fuel burning by domestic users contributed 78% and commercial, industrial and governmental fuel users contributed 19% of the 98 pounds per day of benzopyrene.

(9) For particulate matter, industrial operations and electrical power generation contributed respectively 61% and 15% of the daily discharge of 658 tons.

(10) Data indicate that photochemically active organic compounds represent 50% of the daily discharge of 2265 tons of organics within the Delaware Valley.

(11) Of the 658 tons of particulate matter discharged to the air, approximately 40% are two microns or less in size.

(12) Although the exact geographical distribution of pollutant emissions throughout the Delaware Valley was not determined, it was estimated that the preponderance of emissions (85%) occurred within 20 miles on each side of the Delaware River.

(13) The monthly variation of the average daily rate for total pollutants discharged in the Delaware Valley was less than 10% of the yearly average daily rate.

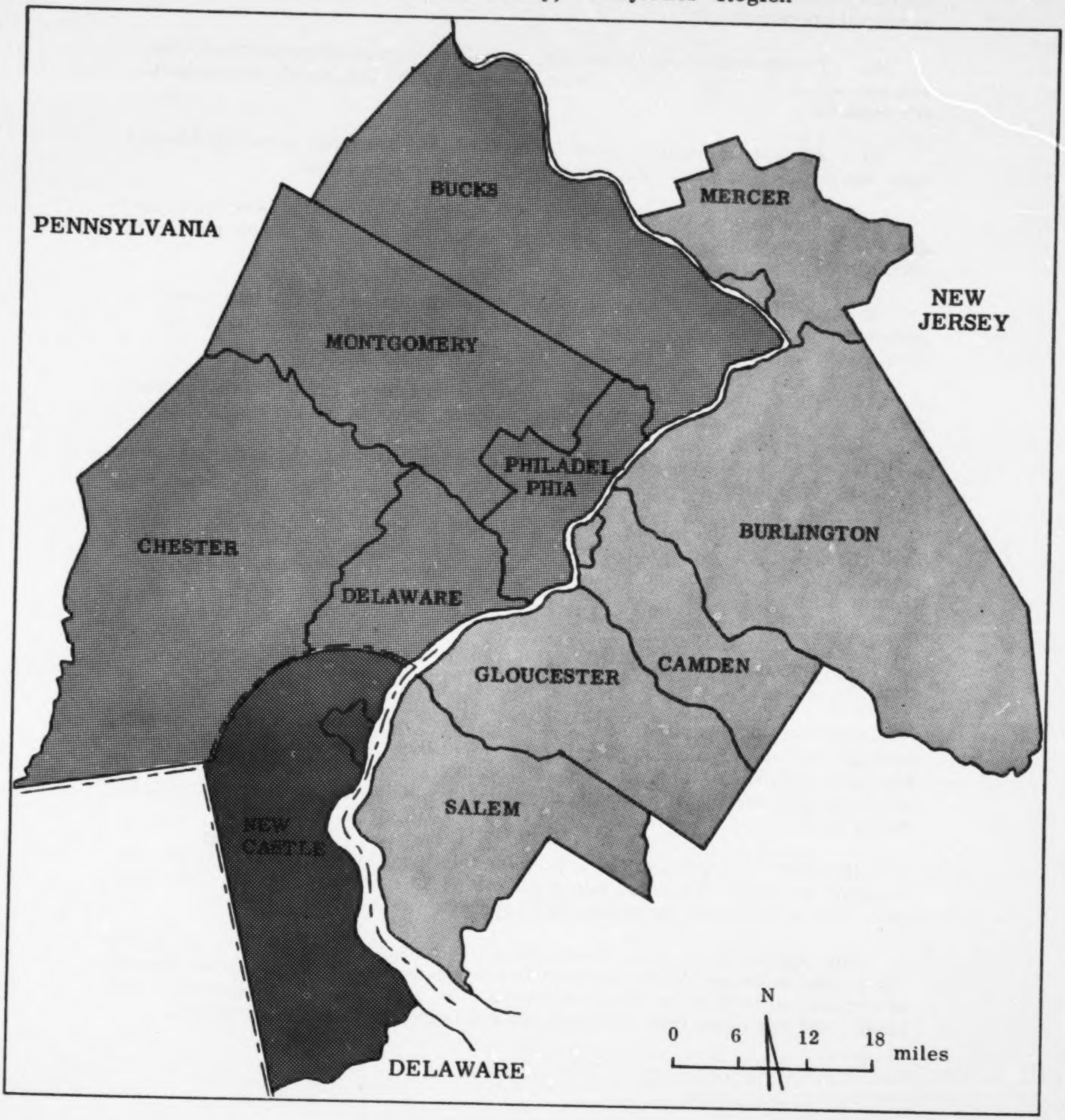
(14) For individual pollutants (benzopyrene omitted), the maximum monthly variation of the daily discharge rate was 17% of the yearly averaged daily rate. For these pollutants, the maximum rate occurred during the winter months. The minimum rate varied depending on the pollutant, but usually occurred during the Spring or Fall.

(15) For benzopyrene, the maximum discharge rate of 228 pounds per day occurred in January while the minimum rate of 3 pounds per day was found during June, July and August; the yearly daily average was 98 pounds per day.

(16) On the basis of an investigation into nuisance complaints on air pollution by the Delaware Valley Regional Development Council of the Junior Chamber of Commerce, 40% of the total complaints were located in Philadelphia City and County and 40% came from Montgomery and Delaware Counties combined.

Figure 2

The Delaware Valley, "Penjerdel" Region



III DETAILS OF FINDINGS

A. Delaware Valley

The Delaware Valley, sometimes called the Penjerdel Region, centers around the neighboring cities of Philadelphia and Camden. Over 5.6 million people live in the 11-county, 3-state area. The Delaware Valley may be considered as a rectangle 80 x 57 miles (4,565 square miles), oriented in a northeast to southwest direction.

The Delaware Valley is the middle of a very much larger megalopolis area extending from Maine to Virginia along the eastern seaboard. More than 50 million people reside, work, and play in this crowded area.

By the year 2000, it is anticipated that the population will increase to 8.5 million in the Delaware Valley.

One of America's great rivers, the Delaware, flows through the center of the Penjerdel region. Much of industry is located close to the Delaware River, which is navigable from Wilmington as far as Trenton. Adjacent to the river, there are hills as high as 500 feet above sea level.

A great diversity of industrial organizations are located in the Delaware Valley. Over 9000 manufacturing establishments provide employment for the population. Farming is conducted in all counties other than Philadelphia. The region's economy supports a wide range of educational, religious, cultural and recreational activities.

It is anticipated that the face of Delaware Valley will change markedly in the future. The Valley's fortunate geographical location in the middle of the eastern seaboard megalopolis will provide the impetus for more people and more industry.

Today's population of 5.6 million is governed by 387 separate units of general government. These governmental units range in size from more than 2 million to fewer than 20 people.

B. Regional Conference of Elected Officials

The Regional Conference of Elected Officials (RCEO) is a voluntary, advisory, nonprofit, nonpartisan advisory corporation of the chief elected officials of local governments within the Delaware Valley. The RCEO organization is dedicated to the preservation of existing local government by aiding members in the solution of mutual and regional problems through study, discussion and cooperation.

Air pollution was one of the first program issues adopted by RCEO for study. Member governments (Figure 3) supported the survey, which was designed to give impetus to the development of an effective Air Resources Management Program for the Delaware Valley. The air pollution survey consisted of four parts:

1. EMISSION INVENTORY - to determine the geographical distribution, types, and quantities of major air pollution emissions throughout the Delaware Valley.

2. ANALYSIS OF EXISTING WEATHER DATA - to determine existing and potential patterns of concentration and dispersion of pollutants by analysis of existing climatological and air pollution data.

3. INTERGOVERNMENTAL RELATIONSHIPS - to study the existing legal and governmental capabilities of the various levels of government to undertake controls and to determine the kinds and distribution of governmental powers, controls, and service functions necessary to achieve and maintain a desirable level of air purity in the Delaware Valley.

4. ADMINISTRATION - to supervise and coordinate the preceding technical portions; to inform local government officials, and civic, business, and industrial leaders of the problem and the results of the survey; and to develop a regional consensus on the most desirable course of action for obtaining a high level of air quality in the Delaware Valley.

C. Emission Inventory Procedure

An emission inventory may be compared to a parts or raw material inventory for a large corporation. For a smoothly running industrial organization, it is essential that a detailed accounting of the amount of raw materials is known on a regular time basis. So it is with the source emission inventory for a smoothly functioning air pollution control agency.

However, an urban community consists of a complex arrangement and number of public, commercial, industrial and institution operations. These activities involve the use of such air-polluting sources as motor vehicles, buses, railroads, airplanes, rockets, home heating, refuse disposal, factories and powerplants. Air pollution starts with the production of emissions - often as undesirable or incidental consequences of these public, commercial, industrial and institutional necessities. Despite the complexity of air pollution, it is possible to account for the amount of air pollutants discharged into the air of a given region and such tabulations may be used as an objective measurement of air pollution. While a parts inventory could be made very accurate, a source emission survey (because of the complexities noted above) is not as accurate; a well prepared emission inventory should be accurate within 25%.

The objectives of the present study are to determine the discharge rate of pollutants, listed in Table 1, subdivided by major source category (Table 2) for 1965. An average daily emission rate was determined for each month to indicate seasonal variation throughout the year. The geographical distribution of emissions was to be evaluated by County; a further breakdown was to be attempted according to areas of high and low emission density.

Factual data have been collected from a variety of sources for fuels consumed, vehicles registered, refuse burned, industrial employment as well as other useful information to the survey. From the available information, fuel usage for each category was calculated. The weight of emissions was then calculated based upon published factors for each type of fuel consumed.

Figure 3

GOVERNMENTS PARTICIPATING IN THE RCEO AIR POLLUTION SURVEY

- September 1967 -

Bucks County, Pa.

Bucks County
Bristol Borough
Bristol Township
Falls Township
Lower Makefield Township
Middletown Township
Morrisville Borough
New Hope Borough
Solebury Township

Burlington County, N.J.

Bordentown Township
Moorestown Township
Riverside Township

Camden County, N. J.

Camden County
City of Camden
Cherry Hill Township
Lindenwold Borough
Merchantville
Pine Hill
Stratford

Chester County, Pa.

Chester County
Easttown Township
East Whiteland Township
Kennett Square Borough
Upper Uwchlan Township
Uwchlan Township
West Chester Borough
West Goshen Township

Delaware County, Pa.

Brookhaven Borough
City of Chester
Chester Heights Borough
Colwyn Borough
Darby Township
Lansdowne Borough
Marple Township
Springfield Township
Trainer Borough

Gloucester County, N. J.

Logan Township
Paulsboro
West Deptford Township
Woodbury Heights Borough

Mercer County, N. J.

Mercer County
Pennington Borough
Trenton
West Windsor Township
Princeton Township
Hightstown Borough

Montgomery County, Pa.

Montgomery County
Abington Township
Collegeville Borough
East Norriton Township
Lower Gwynedd Township
Lower Merion Township
Lower Moreland Township
Montgomery Township
Plymouth Township
Springfield Township
Upper Gwynedd Township
Upper Merion Township
Upper Moreland Township
West Norriton Township
Whitemarsh Township

New Castle County, Delaware

Middletown
Newark
New Castle (City)
Wilmington
New Castle County

Philadelphia, City and County, Pa.

Salem County, N. J.

Table 1

Classification of Air Pollutants

Pollutant	Components
1 - Oxides of Sulfur, SO_x	Sulfur Dioxide, Sulfur Trioxide.
2 - Oxides of Nitrogen, NO_x	Nitrogen Dioxide, Nitric Oxide.
3 - Organic Compounds	Hydrocarbons, Aldehydes, Organic Acids. Other Organic Compounds. Estimate photochemically reactive fraction of Organic Compounds.
4 - Carbon Monoxide, CO	Carbon Monoxide
5 - Carcinogens	Benzopyrene and other like compounds
6 - Particulates	Estimate Fraction of particulate matter smaller than 2 microns

Table 2

Classification of Sources

Source Category Classification	Data Reference Source	Details in Appendix
Transportation Emissions	Fuel and gasoline sales, registration data traffic surveys, direct inquiry	A
Domestic Fuel Burning	Housing census data, fuel suppliers, engineering calculations	B
Commercial, Institutional and Governmental Fuel Burning	Direct inquiry, fuel suppliers, engineering calculations, census data, published information	C
Electrical Power Generation	Published information, direct inquiry, engineering calculations	D
Industrial Fuel Burning and Process Emissions	Direct inquiry, engineering calculations	E
Refuse Burning	Municipal agencies, direct inquiry, engineering calculations	F
Other Sources (Solvent Losses)	Direct inquiry, engineering calculations	G
Resumé of Results (complaints photo-chemical compounds, particulate size, geographical distribution)	Appendices A-G, direct inquiry, published information, engineering calculations	H

As previously noted, this portion of the report will summarize the results of the evaluated information. Detailed calculations are presented in the appendices (Table 2).

D. Emission Inventory Results

1. Total Emissions by County

Table 3 shows the 1965 average pollutant discharge rate for the Delaware Valley by county. Two counties, Philadelphia and Delaware, accounted for 50% of the total pollutant discharge rate of 15,175 tons per day. The other nine counties were responsible for the remainder of the discharge rate. Figures 4 through 8 graphically show the comparison of total emissions within the 11 counties of the Delaware Valley.

2. Emissions by County and Source Category

The average daily emissions by county and by category are shown in Tables 4 through 9. Total pollutants are subdivided into source of emission in Figure 9.

For oxides of sulfur, electrical power generation and industrial sources discharged 2406 tons per day or 93% of the total rate of 2597 tons/day (Table 4). Philadelphia and Delaware Counties accounted for 1228 tons per day of oxides of sulfur, (47% of the total).

Data in Table 5 show that transportation, electrical power generation and industrial operations vent 845 tons per day (85%) of oxides of nitrogen into the air in Delaware Valley. The average discharge rate of oxides of nitrogen is 992 tons per day.

Transportation and industrial operations emit 2003 tons per day (88%) of organic compounds into the air. The average discharge rate of organic compounds is 2265 tons per day (Table 6).

For carbon monoxide, transportation and industrial operations are responsible for a discharge of 8518 tons per day (98%) of the total rate of 8663 tons per day as noted in Table 7.

Fuel Burning in domestic, commercial, institutional and governmental units distribute 95 pounds per day of benzopyrene into the air of the region, (97% of the total listed in Table 8).

Table 9 shows the discharge rate of particulates. Of the 658 tons per day, electrical power generation and industrial operations account for a rate of 501 tons per day or 76%.

3. Monthly Variation of Emissions

The monthly variation of pollutants is shown in Table 10, and Figure 10.

Table 3

Emissions of Air Pollutants in Delaware Valley, Annual Average For 1965 -- Tons/Day

County / Pollutant	Bucks	Chester	Delaware	Mont-gomery	Phila.	Burling-ton	Camden	Glou-cester	Mercer	Salem	New Castle	Region Total
Oxides of Sulfur	80	165	446	168	782	110	80	107	246	125	288	2597
Oxides of Nitrogen	52	56	144	92	324	50	49	35	77	38	75	992
Organics	143	93	353	243	770	94	165	110	111	31	152	2265
Carbon Monoxide	506	322	1469	881	2917	342	648	474	422	86	596	8663
Benzo-pyrene *	6	6	6	11	59	4	9	2	6	1	5	115 *
Particulates	40	29	76	71	233	21	34	30	35	40	49	658
Total	821	665	2488	1455	5026	617	976	756	891	320	1160	15,175
Percent of Total	5	4	16	10	33	4	6	5	6	2	8	-

* lbs. per day

Figure 4

Oxides of Sulfur Emissions in Delaware Valley, 1965

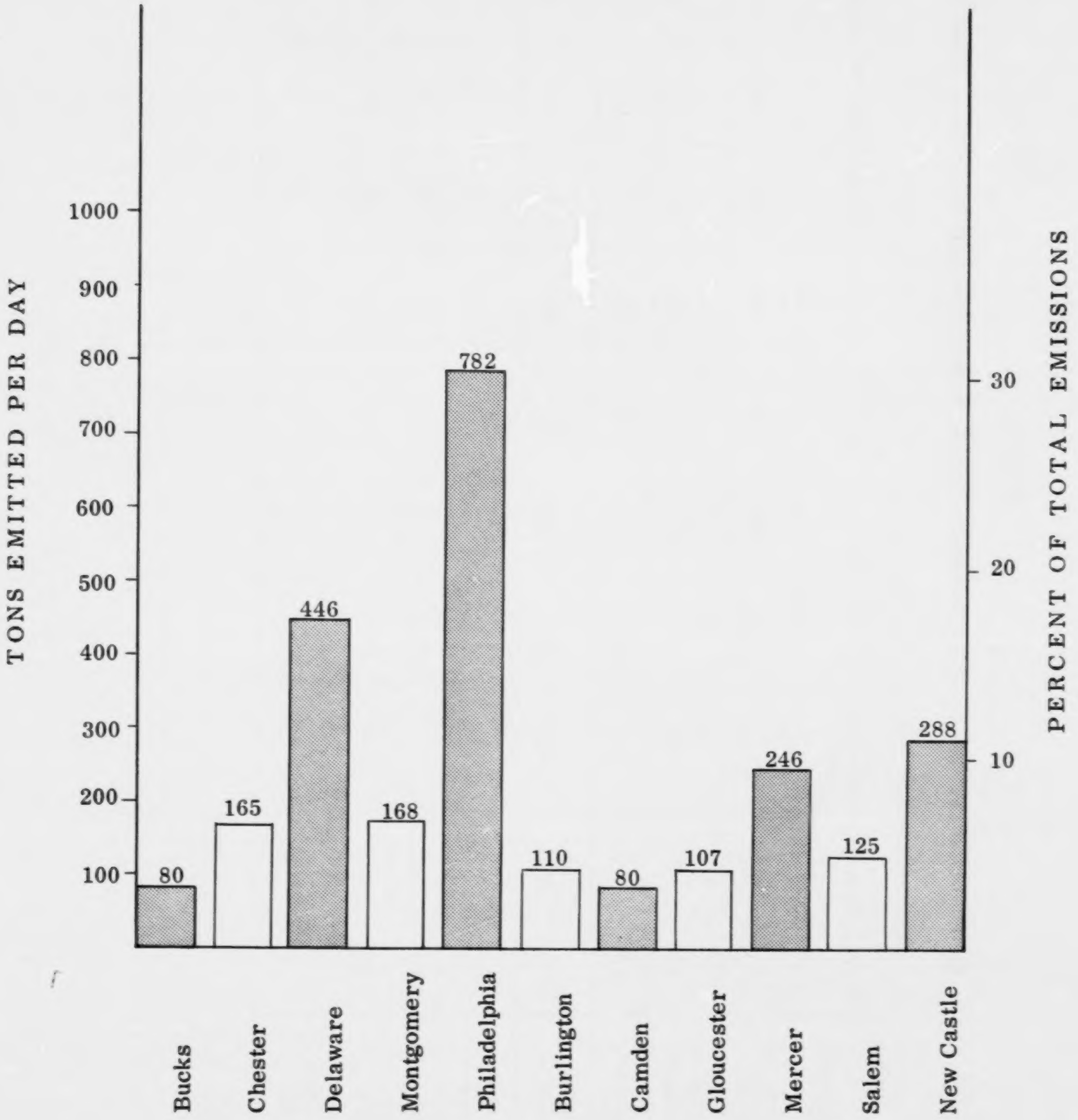


Figure 5

Oxides of Nitrogen Emissions in Delaware Valley, 1965

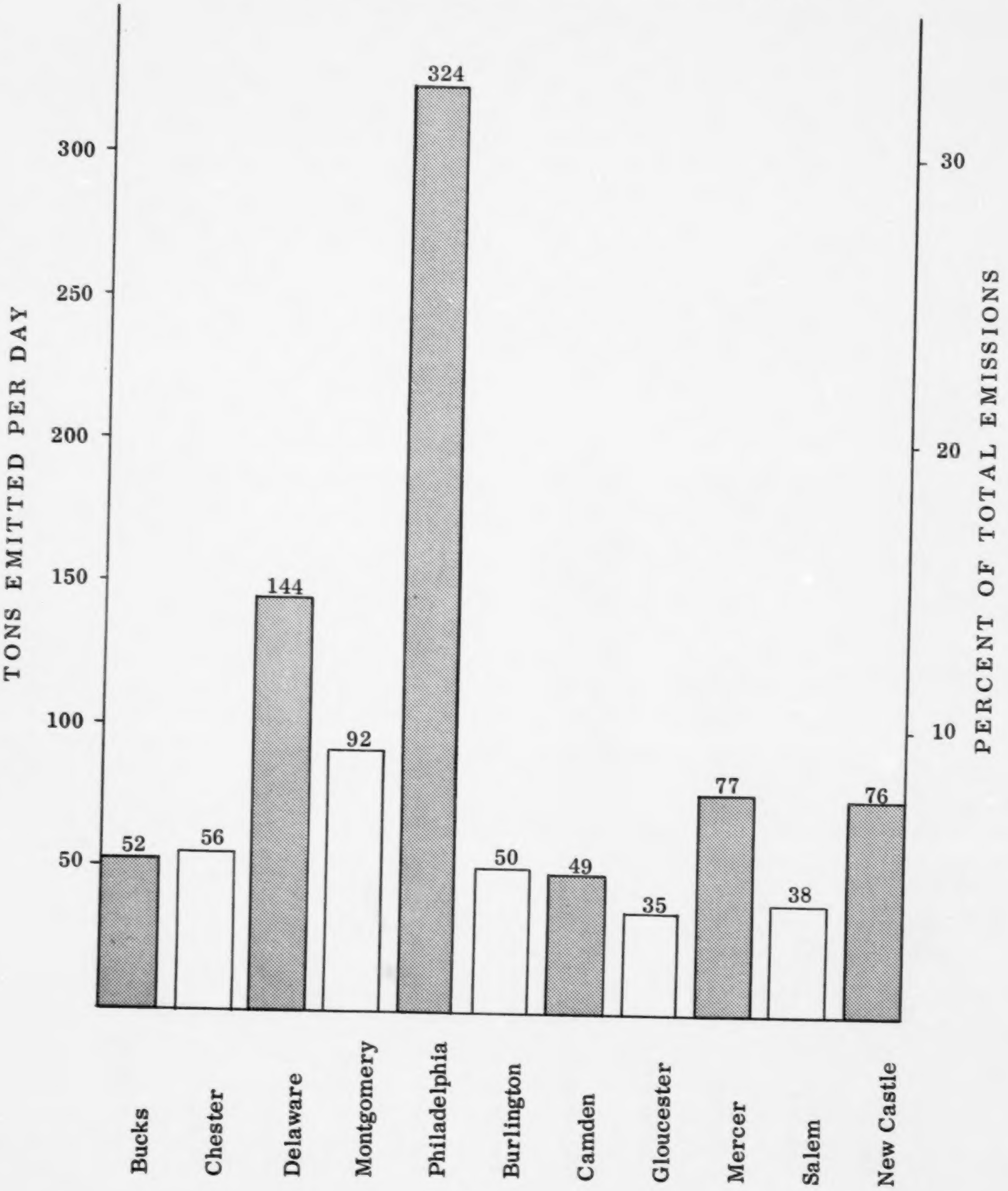


Figure 6

Organic Compound Emissions in Delaware Valley, 1965

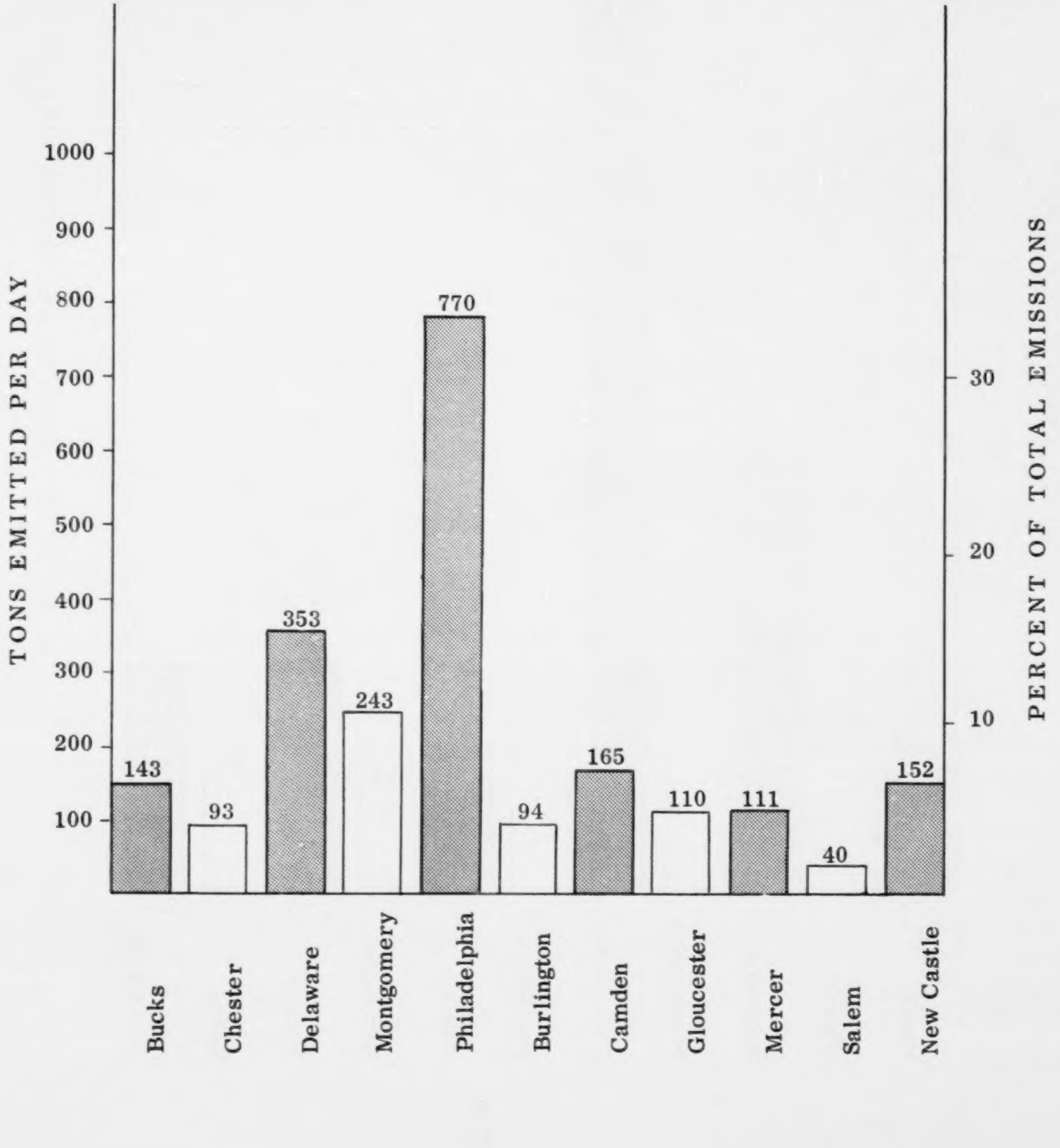


Figure 7

Carbon Monoxide Emissions in Delaware Valley, 1965

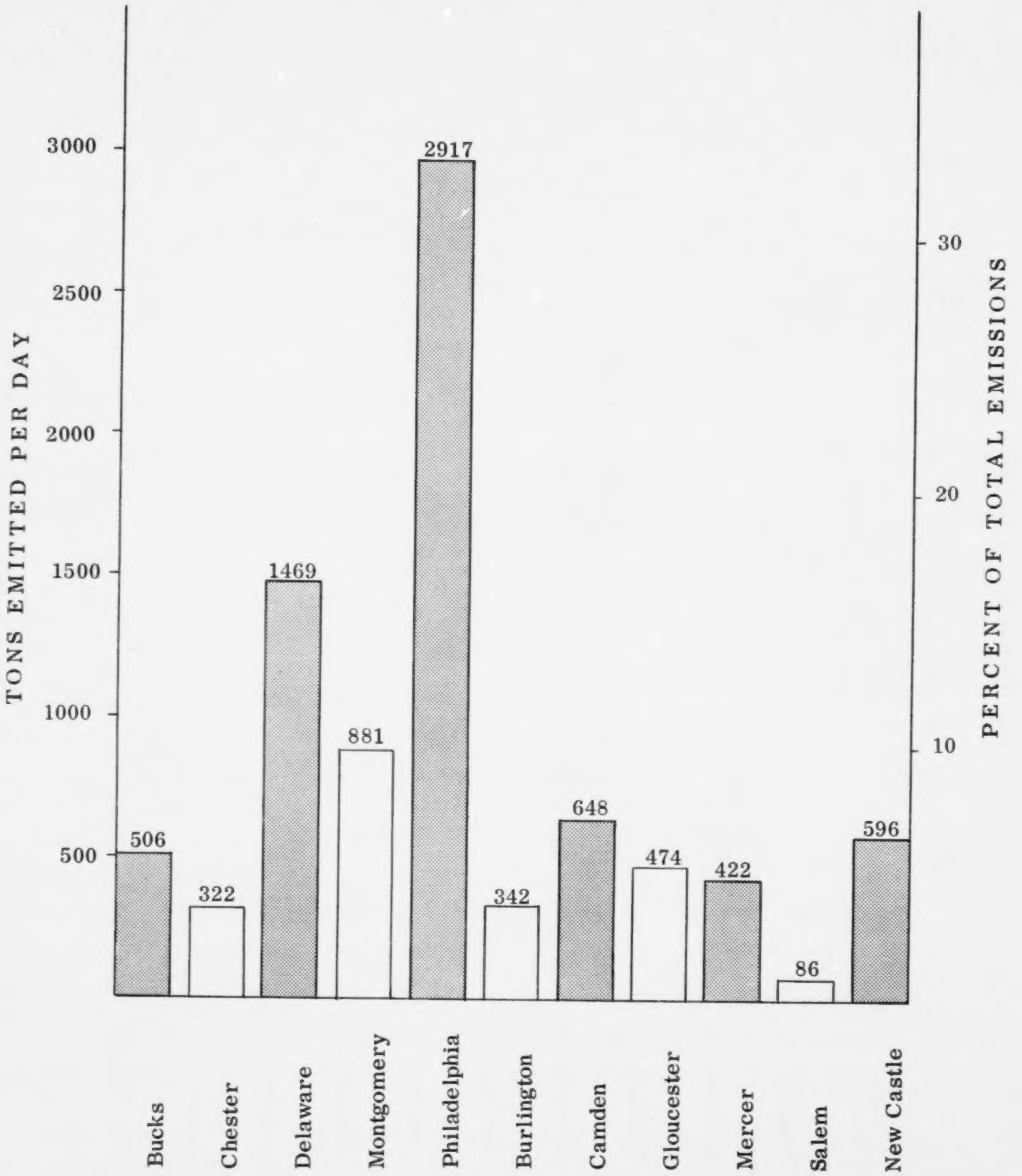


Figure 8

Particulate Emissions in Delaware Valley, 1965

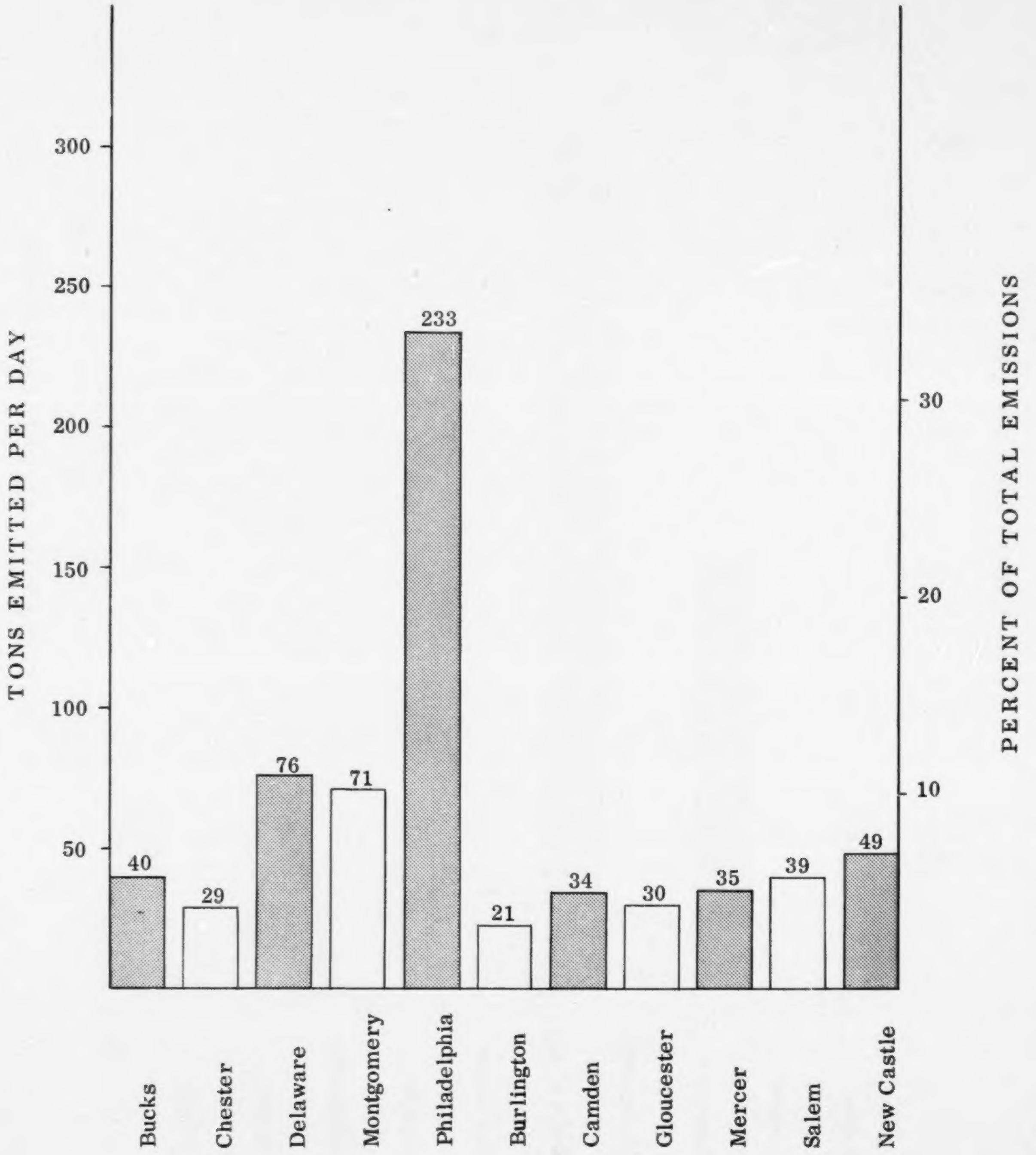


Table 4

Average Daily Emissions of Oxides of Sulfur in Delaware Valley, 1965 -- Tons/Day

County	Transportation	Domestic Fuel	CIG Fuel	Electrical Power	Industrial	Refuse	Average Daily Emission
Bucks	3	7	5	1	64	<1	80
Chester	1	5	4	110	45	<1	165
Delaware	3	8	6	220	208	1	446
Montgomery	3	10	8	31	115	1	168
Philadelphia	7	35	25	299	412	4	782
Burlington	2	4	3	72	29	<1	110
Camden	2	7	5	-	66	<1	80
Gloucester	1	2	1	24	79	<1	107
Mercer	2	5	4	198	36	1	246
Salem	1	1	1	91	31	<1	125
New Castle	2	6	5	205	70	<1	288
TOTAL	27	90	67	1251	1155	7	2597
Percent of Total	1	4	3	48	44	<1	-

Table 5

Average Daily Emissions of Oxides of Nitrogen in Delaware Valley, 1965 -- Tons/Day

County	Transportation	Domestic Fuel	CIG Fuel	Electrical Power	Industrial	Refuse	Average Daily Emission
Bucks	22	9	2	1	18	<1	52
Chester	13	5	1	23	14	<1	56
Delaware	33	12	3	52	43	1	144
Montgomery	34	12	3	7	35	1	92
Philadelphia	86	40	10	82	102	4	324
Burlington	14	5	1	21	9	<1	50
Camden	21	9	2	-	17	<1	49
Gloucester	9	3	1	6	16	<1	35
Mercer	17	7	2	38	12	1	77
Salem	4	2	1	21	10	<1	38
New Castle	19	8	2	28	18	<1	75
TOTAL	272	112	28	279	294	7	992
Percent of Total	27	11	3	28	30	1	-

Table 6

Average Daily Emissions of Organic Compounds in Delaware Valley, 1965 -- Tons/Day

County	Transportation	Domestic Fuel	CIG Fuel	Electrical Power	Industrial	Refuse	Solvents	Average Daily Emission
Bucks	104	4	1	<1	23	4	7	143
Chester	65	3	1	<1	16	3	5	93
Delaware	163	6	2	1	161	7	13	353
Montgomery	164	6	2	<1	52	6	13	243
Philadelphia	415	27	7	2	251	23	45	770
Burlington	66	3	1	1	13	4	6	94
Camden	107	5	1	-	39	3	10	165
Gloucester	42	2	1	<1	61	1	3	110
Mercer	81	3	1	<1	16	3	7	111
Salem	18	1	<1	<1	10	1	1	31
New Castle	93	4	1	<1	43	3	8	152
TOTAL	1318	64	18	4	685	58	118	2265
Percent of Total	58	3	1	<1	30	3	5	-

Table 7

Average Daily Emissions of Carbon Monoxide in Delaware Valley, 1965 -- Tons/Day

County	Transportation	Domestic Fuel	CIG Fuel	Electrical Power	Industrial	Refuse	Average Daily Emission
Bucks	470	4	1	<1	27	4	506
Chester	294	4	1	1	19	3	322
Delaware	735	4	1	1	720	8	1469
Montgomery	745	7	2	<1	120	7	881
Philadelphia	1928	38	10	1	933	7	2917
Burlington	306	3	<1	<1	28	5	342
Camden	495	6	1	-	142	4	648
Gloucester	195	1	<1	<1	276	2	474
Mercer	380	4	1	1	33	3	422
Salem	82	1	<1	<1	2	1	86
New Castle	428	3	1	1	160	3	596
TOTAL	6058	75	18	5	2460	47	8663
Percent of Total	70	1	<1	<1	28	1	-

Table 8

Average Daily Emissions of Benzopyrene in Delaware Valley, 1965 -- Pounds/Day

County	Transportation	Domestic Fuel	CIG Fuel	Electrical Power	Industrial	Refuse	Average Daily Emission
Bucks	<1	4	1	<1	<1	<1	5
Chester	<1	4	1	<1	<1	<1	5
Delaware	1	4	1	<1	<1	<1	6
Montgomery	<1	7	2	<1	<1	<1	9
Philadelphia	1	39	10	<1	<1	<1	50
Burlington	<1	3	1	<1	<1	<1	4
Camden	<1	6	1	-	<1	<1	7
Gloucester	<1	1	<1	<1	<1	<1	1
Mercer	<1	4	1	<1	<1	<1	5
Salem	<1	1	<1	<1	<1	<1	1
New Castle	1	3	1	<1	<1	<1	5
TOTAL	3	76	19	<1	<1	<1	98
Percent of Total	3	78	19	<1	<1	<1	-

Table 9

Average Daily Emissions of Particulates in Delaware Valley, 1965 -- Tons/Day

County	Transportation	Domestic Fuel	CIG Fuel	Electrical Power	Industrial	Refuse	Average Daily Emission
Bucks	4	3	1	1	29	2	40
Chester	2	3	1	1	20	2	29
Delaware	5	4	1	11	48	7	76
Montgomery	6	5	1	4	50	5	71
Philadelphia	16	24	6	30	140	17	233
Burlington	3	2	1	2	11	2	21
Camden	3	4	1	-	24	2	34
Gloucester	1	1	<1	9	18	1	30
Mercer	3	3	1	6	19	3	35
Salem	1	1	<1	19	19	<1	40
New Castle	3	3	1	16	24	2	49
TOTAL	47	53	14	99	402	43	658
Percent of Total	7	8	2	15	61	7	-

Figure 9

Sources of Air Pollution Emissions in the Delaware Valley - 1965

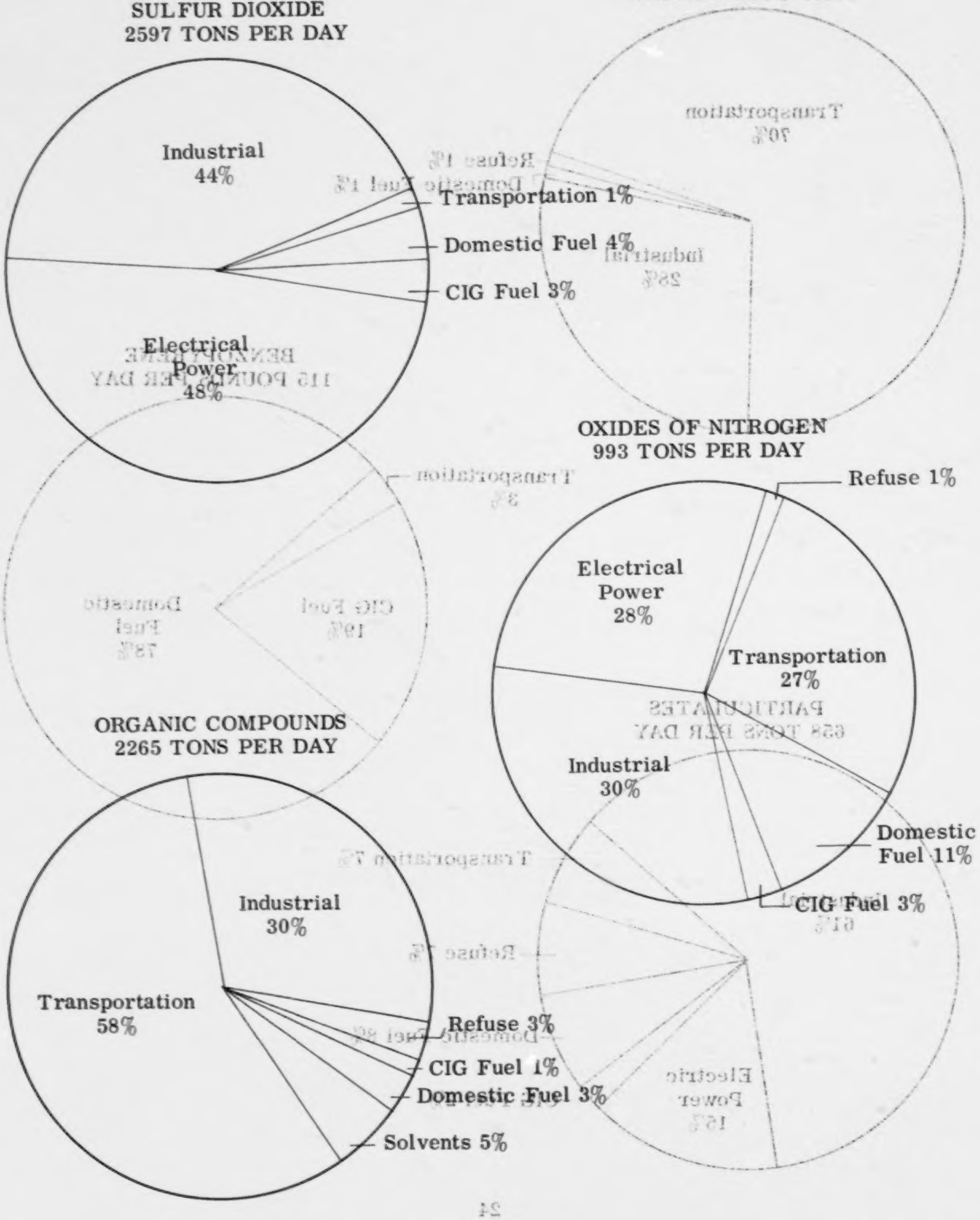


Figure 9 (cont'd.)

Sources of Air Pollution Emissions in the Delaware Valley - 1965

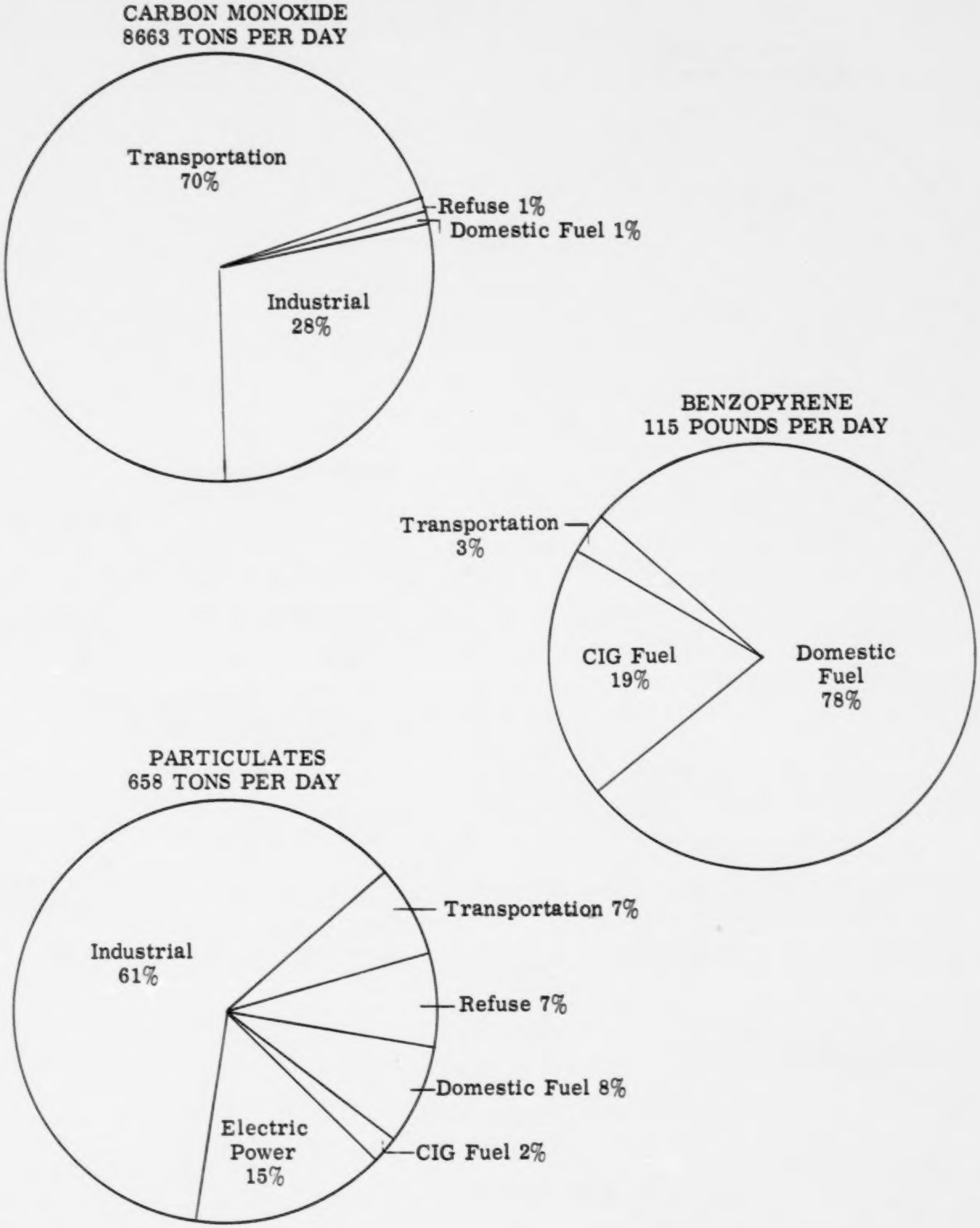


Table 10

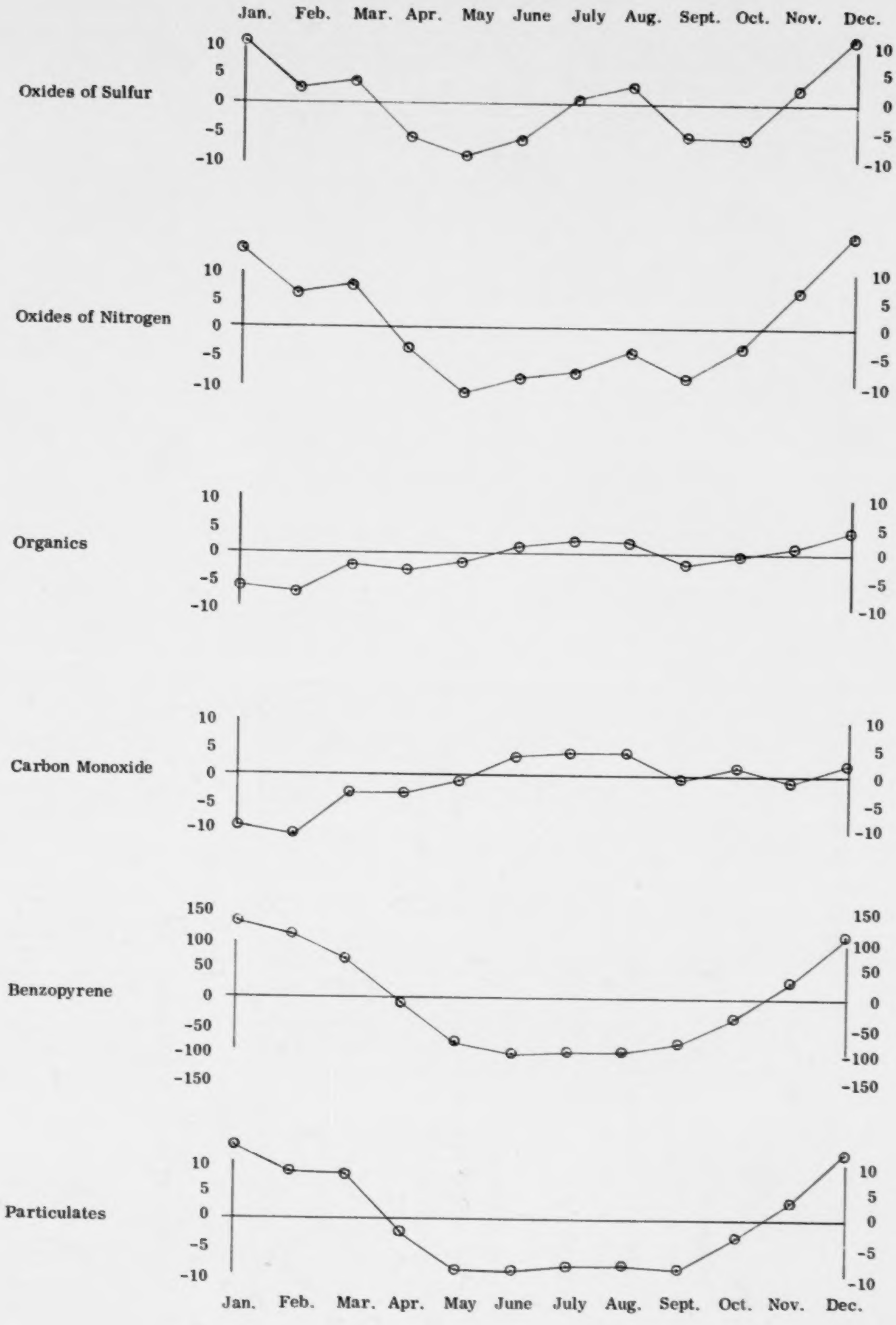
Monthly Pollutant Emission Variation in Delaware Valley - 1965

Pollutant		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Ave. Day
Oxides of Sulfur	Tons/Day	2877	2667	2711	2459	2341	2442	2611	2677	2449	2489	2661	2866	2597
	% Variation(1)	10.8	2.7	4.4	-5.3	-9.9	-6.0	0.5	3.1	-5.7	-5.2	2.5	10.4	
Oxides of Nitrogen	Tons/Day	1137	1055	1066	954	881	895	915	944	899	957	1045	1162	992
	% Variation(1)	14.6	6.4	7.5	-3.8	-11.2	-9.8	-7.8	-4.8	-9.4	-3.5	5.3	17.1	
Organics	Tons/Day	2148	2107	2220	2201	2238	2275	2302	2299	2220	2260	2268	2355	2265
	% Variation(1)	-5.2	-7.0	-2.0	-2.8	-1.2	0.4	1.6	1.5	-2.0	-0.2	0.1	4.0	
Carbon Monoxide	Tons/Day	7834	7698	8415	8415	8612	8920	9045	9045	8640	8747	8647	8836	8663
	% Variation(1)	-9.6	-11.1	-2.9	-2.9	-0.6	3.0	4.4	4.4	-0.3	1.0	-0.2	2.0	
Benzopyrene*	Lbs/Day	228	206	166	97	27	3	3	3	13	61	133	213	98*
	% Variation(1)	132.7	110.2	69.4	-1.0	-72.4	-96.9	-96.9	-96.9	-86.7	-37.8	35.7	117.3	
Particulates	Tons/Day	747	714	710	644	595	594	602	605	596	628	682	740	658
	% Variation(1)	13.5	8.5	7.9	-2.1	-9.6	-9.7	-8.5	-8.1	-9.4	-4.6	3.6	12.5	
TOTAL	Tons/Day	14743	14241	15122	14673	14667	15126	15475	15570	14804	15081	15303	15959	15175
	% Variation(1)	-2.8	-6.2	-0.3	-3.3	-3.3	-0.3	2.0	2.6	-2.4	0	0.8	5.2	

* Pounds/Day
(1) % Variation from Average Day

Figure 10

Monthly Variation In Pollution Emissions
Delaware Valley - Percent of Average, 1965



The discharge rate of pollutants, with the exception of benzopyrene, was reasonably constant throughout the year. The maximum monthly variation from the average daily rate was ± 15% for oxides of nitrogen and particulate matter. The monthly variation for the other pollutants ranged from ± 3% to ± 10% of the average daily rate for the year.

Sulfur dioxide emissions are highest in the winter months and lowest during spring and fall. An increase in sulfur dioxide emissions during July and August is evident, and is due to the increased power generation resulting from air conditioning demands.

Pollutants from burning fuel for space heating and other purposes are 20 percent higher in the winter months (oxides of nitrogen and particulates are good examples). Carbon monoxide and organics are largely attributed to vehicular sources, and are somewhat above average during summer months.

For benzopyrene, the monthly variation was much greater, ranging from 228 poounds per day in January to a low of 3 pounds per day during the summer months. Small fuelburning sources, burning fuel entirely for space heating, are largely responsible for this emission.

IV CONCLUSION

It is considered important to evaluate the mass of data presented in this report and appendices. The conclusions may be emphasized in just four vital points.

(1) The daily weight of air pollutants discharged into the Delaware Valley is titanic. It is provocative to compare the emissions from the 11-county area with those from the slightly smaller, populationwise, 6-county San Francisco area:

	TONS per DAY EMITTED	
	Delaware Valley, 1965	San Francisco 1964
Oxides of sulfur	2597	380
Oxides of nitrogen	992	530
Organic compounds	2265	2030
Carbon monoxide	8663	6640
Particulate matter	658	200

The outpour of sulfur oxides in the Delaware Valley is six times that in the San Francisco region--particulate matter is three times greater here--and oxides of nitrogen are twice as high. Although the emission rates of organic compounds and carbon monoxide are comparable between the two regions, the San Francisco Bay Area Air Pollution Control District has recently passed a regulation to reduce organic compound emissions from stationary sources. Carbon monoxide levels may be reduced coincidently.

Although the high discharge rates in the Delaware Valley are partially attributed to the type of fuel used and a more extreme climate, the lower discharge rates in the Bay Area reflect good air pollution laws, coupled with strong enforcement policies.

(2) Air pollution means people; people create air pollution. The City and County of Philadelphia which contains 36% of the population of the Delaware Valley, emits almost a like percentage (33%) of the total air pollutants.

Furthermore, people work and live close to the Delaware River. Although this cordon area is only 27% of the area of the Delaware Valley, 85% of the total air pollutants are discharged within this zone.

Clearly, the air over the Delaware Valley can not provide a self-cleansing mechanism in such a small area.

(3) Although air pollution is a people-problem, an overwhelming fraction of each pollutant is the responsibility of three sources. The accountability of sources for different pollutants is delineated in the following table.

Pollutant	Source Category with Major Responsibility
Oxides of Sulfur	Industrial operations Electrical power generation
Oxides of Nitrogen	Industrial operations Electrical power generation Transportation
Organic Compounds	Transportation Industrial operations
Carbon Monoxide	Transportation Industrial operations
Benzopyrene	Domestic fuel burning commercial, institutional, and governmental fuel burning
Particulates	Industrial operations Electrical power generation

The preponderance of air pollutants is the liability of:

Industrial operations
Electrical power generation, and
Transportation

Each of these activities are essential to an urban area. The thought-provoking question is, "How can we reduce pollutant emissions from these sources in the most equitable manner?"

(4) It is basic to understand that total tonnages of pollutants are discharged to the air over the Delaware Valley at essentially a constant rate throughout the year. The maximum monthly variation throughout the year was 6% from the average; individual pollutants varied as much as 17% (except for benzopyrene). Thus the discharge rate of pollutants is constant throughout the year--varying for individual pollutants from 3% to 17% of the annual average in any month.

In general, the smallest magnitude of emissions occur during the spring and fall months. The most prevalent emissions during the winter months are those pollutants associated with "London type" smog (oxides of sulfur and particulates). The increased organic emissions, coupled with elevated temperatures and brilliant sunlight during the summer months, are associated with "Los Angeles type" photochemical smog. The Delaware Valley, therefore, experiences both phenomena.

The relative constancy of emissions means that an air pollution episode or calamity could occur during any day, any week, or any month of any year. So whenever the weather stagnates, pollutant levels will increase; in other areas similar to the Delaware Valley, deaths occurred when adverse weather conditions existed for more than several days.

At present, technology can not control the weather. Technology can economically reduce the discharge of pollutants to the air.

APPENDIX A

EMISSIONS FROM TRANSPORTATION SOURCES IN THE DELAWARE VALLEY

I INTRODUCTION

Air pollution emissions from transportation sources are those pollutants from the burning of fuel for automobiles, trucks, buses, ships, railroads, and airplanes. The types of fuel used includes gasoline as well as diesel, distillate and residual oils. The consumption of coal for transportation purposes was negligible. Mass transit systems powered by electricity are not included in this appendix (see Appendix D).

The increase in occurrence of photochemical air pollution in many urban areas has focused attention on the growing problem of vehicular pollution emissions, particularly the automobile. Motor vehicle registration density in the Delaware Valley has increased at a rate faster than population growth. The Philadelphia metropolitan area has one of this country's greatest concentration of vehicles per square mile, and, at the present rate of growth in automobile ownership and traffic density, indications are that the magnitude of pollution emissions from vehicular sources may continue to increase in the future in spite of the gradual curbing influence of control devices that are being installed on new cars.

II METHODOLOGY

Emissions from transportation sources were calculated from the gallons of fuel consumed for each type of vehicle. In most cases, the fuel usage was determined by several methods which gave comparable results. Standard emission factors applied to the fuel consumption data were used to obtain the weight of pollutants discharged.

III CALCULATIONS

A. Fuel Consumption

1. Gasoline

The gasoline fuel sales for Pennsylvania, New Jersey and Delaware(1) were subdivided on a county basis in accordance with vehicle registration data(2-4) as listed in Table A-1.

Based upon these data, the average vehicle of the types listed consumes about 715 gallons of gasoline per year in the Delaware Valley.

Gasoline sales vary seasonally from a low during February to a peak during July and August(1). Emissions from automobiles were adjusted using the monthly factors shown in Table A-2. It was noted that the automobile usage (and hence gasoline consumption) was greatest on Friday and lowest on Saturday and Sunday.

Table A-1

Vehicle Registration and Gasoline Sales in Delaware Valley - 1965

County	Passenger and Commercial Vehicles Registered	Gasoline used, Gal/day *
Bucks	163,953	320,000
Chester	101,904	199,000
Delaware	258,289	506,000
Montgomery	261,306	512,000
Philadelphia	674,982	1,320,000
Burlington	108,523	212,000
Camden	173,697	340,000
Gloucester	67,062	132,000
Mercer	129,962	253,000
Salem	28,404	55,000
New Castle	149,684	293,000
TOTAL	2,117,766	4,142,000

*Based upon a ratio of registered vehicles to gasoline sales.

Table A-2

Variation of Traffic Flow in the Delaware Valley - 1965

Month of Year	National Fuel Use, % of Avg. Month	Local Fuel Use, % of Avg. Month (a)	Local Auto Count, % of Avg. Month (b)	Estimated Variation, % of Avg. Month (c)
January	85.6	85.8	83.5	84
February	84.0	84.8	73.3	82
March	95.2	96.4	85.5	94
April	97.1	98.5	92.8	96
May	101.5	100.8	103.1	102
June	108.3	103.0	106.1	106
July	110.7	105.2	110.2	108
August	107.6	102.9	114.5	108
September	100.5	101.3	101.0	101
October	103.4	100.7	103.1	102
November	100.8	98.5	98.0	99
December	102.0	102.4	89.7	101

(a) Average for Pennsylvania, New Jersey and Delaware(1)

(b) Based upon vehicle counts on Delaware River Bridges(5)

(c) Weighted average of other columns.

2. Diesel Oil for Trucks and Buses

Diesel trucks and buses registered in the 11 counties are listed in Table A-3. State registration data are not specific for diesel vehicles. Estimates of total registration for the country have been published(7). For the Delaware Valley, it was estimated that diesel vehicles approximate 25% of the total trucks,trailers and buses registered in Pennsylvania, New Jersey and Delaware(2, 3, 4, 6).

Based upon a national average, diesel trucks consume 1,362 gallons of diesel oil per year and diesel buses consume 2,815 gallons per year(7). The weighted average for both trucks and buses, as a national average, is 1,600 gallons. Similar data for Pennsylvania gave a consumption rate of diesel oil per vehicle of 3,300 gallons per year(8). For the Delaware Valley area, it was decided to use an estimate of 2,000 gallons per vehicle per year or approximately 5.5 gallons per vehicle per day. Diesel fuel usage by road vehicles within the 11 counties is also shown in Table A-3.

3. Diesel Oil for Railroads

The diesel oil consumption by railroads in the Delaware Valley was based upon a ratio of the miles of mainstem tracks in each county(9) to the total trackage and fuel consumption in each state(8). Diesel oil usage for railroads is presented in Table A-4.

4. Fuel Oil for Vessels

More than 7000 major cargo ships navigate the 135 mile span of the Delaware River yearly(10). Since there are many active ports along this span from the Atlantic ocean to Trenton, New Jersey, very little factual information is available on the use of fuel oil by vessels through the entire port complex.

Data was obtained for total fuel oil consumption by vessels in Pennsylvania, New Jersey, and Delaware(8). It was assumed that two percent of this fuel was used within the study area. The breakdown of fuel usage for vessels is given in Table A-5.

5. Airplane Fuel

Pollutant emissions from commercial aircraft were based upon the number of flights from the four major airports in the Delaware Valley. Flight emissions include averaged emissions during all phases of aircraft operation, (taxi, takeoff, climbout, approach, and landing), which take place below 3500 feet elevation. The yearly flights from the major airports are given in Table A-6(10).

Flight data for military aircraft operating in the Delaware Valley were not available; consequently, emissions were based upon state-wide jet fuel consumption for military aircraft. This usage was proportioned to the 11 county region on an area ratio basis. An estimated 296,000 bbl of jet fuel were used for military operations in the Delaware Valley during 1965.

Table A-3

Diesel Vehicle Registration and Diesel Fuel Sales in Delaware Valley - 1965

County	Diesel Vehicles Registered*	Diesel Fuel Used, Gal/day
Bucks	1,611	8,861
Chester	1,001	5,506
Delaware	2,540	13,970
Montgomery	2,562	14,091
Philadelphia	6,630	36,465
Burlington	970	5,335
Camden	1,410	7,755
Gloucester	842	4,631
Mercer	1,178	6,479
Salem	427	2,349
New Castle	1,413	7,772
TOTAL	20,584	113,214

*Registration data are not specific, figures may include tractor plus trailers used with diesel tractor.

Table A-4

Diesel Oil Consumption for Railroads in Delaware Valley - 1965

State and County	Mainstem Tracks, mi	Percent of State tracks	Diesel Fuel Consumer 1000 bbl/yr.	Diesel Fuel Consumed, gal/day
TOTAL PENNSYLVANIA	8,995	100	4,537	
Bucks	-(b)	5(a)	227	26,200
Chester	-	2(a)	91	10,500
Delaware	-	5(a)	227	26,200
Montgomery	-	6(a)	272	31,400
Philadelphia	-	7(a)	318	36,600
TOTAL NEW JERSEY	1,896	100	1,302	
Burlington	103	5.4	70.4	8,100
Camden	98	5.2	67.8	7,800
Gloucester	72	3.8	49.5	5,700
Mercer	76	4.0	52.2	6,000
Salem	36	1.9	24.8	2,860
TOTAL DELAWARE	-	-	32	
New Castle	-	60	19	2,190

(a) Estimated percentage.

(b) Dashed line (-) indicates no data available.

Table A-5

Fuel Oil Consumption for Vessels in the Delaware Valley - 1965

Area	Gallons per day		
	Distillate Oil	Residual Oil	TOTAL
Pennsylvania (Three Counties)	460	7,940	8,400
New Jersey (Five Counties)	2,180	8,260	10,400
Delaware (One County)	60	1,100	1,200
Regional TOTAL	2,700	17,300	20,000

Table A-6

Aircraft Flights in Delaware Valley - 1965

Location	Number of Flights
Philadelphia International Airport	108,909
North Philadelphia Airport	71,224
Wilmington Airport	62,517
Trenton Airport	54,262

B. Emission Factors

1. Gasoline and Diesel Powered Vehicles

Emission calculations were made by multiplying gallons of fuel consumed by published emission factors(11). The organic compound emission factor for gasoline was modified to include a calculated 25% of vehicles with blowby devices(12) and for 120 lb/1000 gal evaporation losses from the fuel tank and carburetor. Vapor loss occurs during service station filling and vehicle operation(11).

Thus:

$$(75\%)\left(\frac{524\text{ lb}}{1000\text{ gal}}\right) + (25\%)\left(\frac{396\text{ lb}}{1000\text{ gal}}\right) + \frac{120\text{ lb}}{1000\text{ gal}} = 613\ \frac{\text{lb}}{1000\text{ gal}}$$

Emission factors for automotive and diesel emissions are given in Table A-7.

2. Railroads and Vessels

Table A-8 lists the emission factors for both railroads and vessels. The emission factors for railroads are those for diesel engines (Table A-7) while the factors for vessels are those for large sources of power (greater than 1000 hp.)(11).

3. Aircraft

The emission factors of Mayer for aircraft(11) was modified because flight data obtained were not categorized into jet, piston and turboprop engine types. To convert the emission factors for use in the survey, it was assumed:

(a) Approximately 40% of all flights use jet engines.

(b) Turboprop flights (2 and 4 engines) were equal in number to piston engine flights (2 and 4 engines).

On this basis, the prepared emission factors are given in Table A-9.

The application of these factors will have varying degrees of accuracy dependent upon the type of activity at each airport.

C. Emissions

1. Gasoline and Diesel Powered Vehicles

Emissions from gasoline and diesel powered vehicles for the Delaware Valley are presented in Tables A-10 and A-11.

As the emissions from road vehicles are not distributed uniformly throughout each county, a more detailed geographical distribution of vehicular emissions will be evaluated in Appendix H. Monthly variation of transportation emissions by county are presented in the final section of this appendix.

2. Emissions from Railroads and Vessels

Emissions from railroads operating in the Delaware Valley during 1965 are shown in Table A-12. Similar data for vessels are listed in Table A-13.

3. Emissions from Aircraft

Aircraft emissions in the Delaware Valley for 1965 are tabulated in Table A-14.

IV SUMMARY OF TRANSPORTATION EMISSIONS

Air pollutant emissions from transportation sources in the Delaware Valley for 1965 by county and by month (average day) are listed in Tables A-15 to A-27.

Emissions from automobiles were obtained on a monthly basis by multiplying values in Table A-10 by the estimated monthly variation in traffic flow as noted in Table A-2. Emissions from diesel powered vehicles were assumed constant throughout the year.

Emissions from railroads, shown in Table A-12, were assumed constant throughout each month of the year. Emissions from vessels (Table A-13) were distributed equally among the nine counties along the Delaware River, and were assumed to be relatively constant throughout the year.

Aircraft emissions were assigned to the county in which the airport was located (Table A-14). Emissions from military aircraft were divided among Burlington, Montgomery and Philadelphia counties.

A summary of emissions from Transportation Sources is shown in Table A-15 and a resume of emissions by month is given in Table A-27.

Table A-7

Automotive and Diesel Emission Factors

Pollutant	lbs per 1000 gal	
	Gasoline Engines	Diesel Engines
Oxides of Sulfur	9	40
Oxides of Nitrogen	113	222
Organics*	621	221
Carbon Monoxide	2910	60
Benzopyrene	0.0007	0.0009
Particulates	11	110

*Includes aldehydes and organic acids, unless otherwise noted.

Table A-8

Railroad and Vessel Emission Factors

Pollutant	lbs per 1000 gal	
	Railroads	Vessels
Oxides of Sulfur	40	320*
Oxides of Nitrogen	222	104
Organics	221	4
Carbon Monoxide	60	0.04
Benzopyrene	0.0009	1.1×10^{-5}
Particulates	110	8

*2% sulfur in fuel assumed

Table A-9

Aircraft Emission Factors

Pollutant	lbs per flight*	lbs per 1000 gal
Oxides of Sulfur	neg	neg
Oxides of Nitrogen	13	37
Organics	15.5	21
Carbon Monoxide	64	56
Benzopyrene	neg	neg
Particulates	14.3	54

*Take off and landing

Table A-10

Emissions from Gasoline Powered Vehicles, 1965 -- Tons/Day

Pollutant	Bucks	Chester	Delaware	Mont-gomery	Phila-delphia	Burling-ton	Camden	Glou-cester	Mercer	Salem	New Castle	Total
Oxides of Sulfur	1.4	0.9	2.3	2.3	5.9	1.0	1.5	0.6	1.1	0.3	1.3	19
Oxides of Nitrogen	18.1	11.2	28.6	28.9	74.6	12.0	19.2	7.5	14.3	3.1	16.6	233
Organics	99.4	61.8	157.1	159.0	408.9	65.8	105.6	41.0	78.6	17.1	91.0	1280
Carbon Monoxide	465.6	289.5	736.2	745.6	1921.	308.5	494.7	192.1	368.1	80.0	419.0	6023
Benzopyrene*	0.2	0.1	0.4	0.4	0.9	0.1	0.2	0.1	0.2	<0.1	0.2	3*
Particulates	1.8	1.1	2.8	2.8	7.3	1.2	1.9	0.7	1.4	0.3	1.6	25

*lbs per day

Table A-11

Emissions from Diesel Powered Road Vehicles, 1965 -- Tons/Day

Pollutant	Bucks	Chester	Delaware	Montgomery	Philadelphia	Burlington	Camden	Gloucester	Mercer	Salem	New Castle	Total
Oxides of Sulfur	0.2	0.1	0.3	0.3	0.7	0.1	0.2	0.1	0.1	0.1	0.2	2
Oxides of Nitrogen	1.0	0.6	1.6	1.6	4.1	0.6	0.9	0.5	0.7	0.3	0.9	14
Organics	1.0	0.6	1.5	1.6	4.0	0.6	0.9	0.5	0.7	0.3	0.9	13
Carbon Monoxide	0.3	0.2	0.4	0.4	1.1	0.2	0.2	0.5	0.2	0.1	0.2	3
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Particulates	0.5	0.3	0.8	0.8	2.0	0.3	0.4	0.3	0.4	0.1	0.4	6

*lbs per day

Table A-12

Emissions from Railroads in Delaware Valley, 1965 -- Tons/Day

Pollutant	Bucks	Chester	Delaware	Montgomery	Philadelphia	Burlington	Camden	Gloucester	Mercer	Salem	New Castle	Total
Oxides of Sulfur	0.5	0.2	0.5	0.6	0.7	0.2	0.2	0.1	0.1	0.1	<0.1	3
Oxides of Nitrogen	2.9	1.2	2.9	3.5	4.1	0.9	0.9	0.6	0.7	0.3	0.2	18
Organics	2.9	1.2	2.9	3.5	4.0	0.9	0.9	0.6	0.7	0.3	0.2	18
Carbon Monoxide	0.8	0.3	0.8	0.9	1.1	0.2	0.2	0.2	0.2	0.1	0.1	5
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	1.4	0.6	1.4	1.7	2.0	0.5	0.4	0.3	0.3	0.2	0.1	9

*lbs per day

Table A-13

Emissions from Vessels in the Delaware Valley 1965 -- Tons/Day

Pollutant	Emission tons/day
Oxides of Sulfur	3.2
Oxides of Nitrogen	1.0
Organics	<0.1
Carbon Monoxide	<0.1
Benzopyrene*	<0.1*
Particulates	0.1

*lbs/day

Table A-14

Emissions from Aircraft in Delaware Valley 1965 -- Tons/Day

Pollutant	Philadelphia County		New Castle County	Mercer County	Military	Total
	Phila. Interntl. Airport	North Phila. Airport	Wilmington Airport	Trenton Airport		
Oxides of Sulfur	neg	neg	neg	neg	neg	--
Oxides of Nitrogen	2.0	1.0	1.0	1.0	1.0	6.0
Organics	2.4	1.5	1.3	1.1	0.6	6.9
Carbon Monoxide	9.6	6.2	5.5	4.4	1.6	27.3
Benzopyrene	neg	neg	neg	neg	neg	--
Particulates	2.2	1.4	1.2	1.0	1.5	7.3

Table A-15

Summary of Emission from Transportation Sources in Delaware Valley, 1965 -- Tons/Day

Pollutant	Gasoline Powered Vehicles (b)	Diesel Powered Vehicles (c)	Railroads (d)	Vessels (e)	Aircraft (f)	GRAND TOTAL
Oxides of Sulfur	19	2	3	3	-	27
Oxides of Nitrogen	233	14	18	1	6	272
Organics	1280	13	18	<0.1	7	1318
Carbon Monoxide	6023	3	5	<0.1	27	6058
Benzopyrene (a)	3	<0.1	<0.1	<0.1	-	3 (a)
Particulates	25	6	9	0.1	7	47
TOTAL	7580	38	53	4	47	7722

(a) lbs/day
(b) Table A-10
(c) Table A-11
(d) Table A-12
(e) Table A-13
(f) Table A-14

Table A-16

Emissions from Transportation Sources in Bucks County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	1.2	1.2	1.4	1.4	1.5	1.5	1.6	1.6	1.5	1.5	1.4	1.5	
Diesel	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
R.R., Vessel, Aircraft	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
Sub Total	2.3	2.3	2.5	2.5	2.6	2.6	2.7	2.7	2.6	2.6	2.5	2.6	2.6
Oxides of Nitrogen													
Auto	15.2	14.8	17.0	17.4	18.4	19.1	19.5	19.5	18.3	18.4	17.9	18.3	
Diesel	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
R.R., Vessel, Aircraft	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Sub Total	19.2	18.0	21.0	21.4	22.4	23.1	23.5	23.5	22.3	23.4	21.9	22.3	22
Organics													
Auto	83.7	81.7	93.8	95.7	101.7	105.7	107.8	107.8	101.0	101.9	99.0	101.0	
Diesel	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
R.R., Vessel, Aircraft	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	
Sub Total	87.6	86.6	97.7	99.6	105.6	109.6	111.7	111.7	104.9	105.8	102.9	104.9	104
Carbon Monoxide													
Auto	392.	382.	438.	448.	475.	495.	504.	504.	471.	475.	462.	471.	
Diesel	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
R.R., Vessel, Aircraft	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Sub Total	393.	383.	439.	449.	476.	496.	505.	505.	472.	476.	463.	472.	470
Benzopyrene*													
Auto	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2*
Particulates													
Auto	1.5	1.4	1.7	1.7	1.8	1.9	1.9	1.9	1.8	1.8	1.7	1.8	
Diesel	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
R.R., Vessel, Aircraft	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
Sub Total	3.5	3.4	3.7	3.7	3.8	3.9	3.9	3.9	3.8	3.8	3.7	3.8	4

*lbs/day

Table A-17

Emissions from Transportation Sources in Chester County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	0.8	0.7	0.9	0.9	0.9	1.0	1.0	1.0	0.9	0.9	0.0	0.9	
Diesel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
R.R., Vessel, Aircraft	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Sub Total	1.1	1.0	1.2	1.2	1.2	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.1
Oxides of Nitrogen													
Auto	9.5	9.2	10.6	10.8	11.5	11.9	12.1	12.1	11.4	11.5	11.1	11.4	
Diesel	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
R.R., Vessel, Aircraft	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
Sub Total	11.3	11.0	12.4	12.6	13.3	13.7	13.9	13.9	13.2	13.3	12.9	13.2	13
Organics													
Auto	51.9	50.6	58.0	59.3	63.0	65.5	66.6	66.6	62.4	63.0	61.2	62.4	
Diesel	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
R.R., Vessel, Aircraft	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
Sub Total	53.7	52.4	59.8	61.1	64.8	67.3	68.4	64.2	64.8	63.0	64.2	64.2	65
Carbon Monoxide													
Auto	243.	238.	273.	278.	295.	307.	313.	313.	293.	295.	287.	293.	
Diesel	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
R.R., Vessel, Aircraft	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Sub Total	244.	239.	274.	279.	296.	308.	314.	314.	294.	296.	288.	294.	294
Benzopyrene*													
Auto	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1*
Particulates													
Auto	0.9	0.1	1.0	1.1	1.1	1.2	1.2	1.2	1.1	1.1	1.1	1.1	
Diesel	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
R.R., Vessel, Aircraft	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Sub Total	1.8	1.8	1.9	2.0	2.0	2.1	2.1	2.1	2.0	2.0	2.0	2.0	2

*lbs/day

Table A-18

Emissions from Transportation Sources in Delaware County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	1.9	1.9	2.2	2.2	2.3	2.4	2.5	2.5	2.3	2.3	2.3	2.3	
Diesel	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
R.R., Vessel, Aircraft	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
Sub Total	3.1	3.1	3.4	3.4	3.5	3.6	3.7	3.7	3.5	3.5	3.5	3.5	3.4
Oxides of Nitrogen													
Auto	24.0	23.5	26.9	27.4	29.2	30.3	30.9	30.9	28.9	29.2	28.3	28.9	
Diesel	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	
R.R., Vessel, Aircraft	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Sub Total	28.6	28.1	31.5	32.0	33.8	34.9	35.5	35.5	33.5	33.8	32.9	33.5	33
Organics													
Auto	132.	129.	148.	151.	160.	167.	170.	170.	159.	160.	156.	159.	
Diesel	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
R.R., Vessel, Aircraft	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	
Sub Total	136.	133.	152.	155.	164.	171.	174.	174.	163.	164.	160.	163.	163
Carbon Monoxide													
Auto	619.	604.	693.	707.	752.	780.	787.	787.	743.	752.	729.	743.	
Diesel	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
R.R., Vessel, Aircraft	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Sub Total	620.	605.	694.	708.	753.	781.	788.	788.	744.	753.	730.	744.	735
Benzopyrene*													
Auto	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4*
Particulates													
Auto	2.3	2.3	2.6	2.7	2.8	2.9	3.0	3.0	2.8	2.8	2.8	2.8	
Diesel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
R.R., Vessel, Aircraft	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
Sub Total	4.6	4.6	4.9	5.0	5.1	5.2	5.3	5.3	5.1	5.1	5.1	5.1	5

*lbs/day

Table A-19

Emissions from Transportation Sources in Montgomery County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	1.9	1.9	2.2	2.3	2.4	2.4	2.5	2.5	2.3	2.3	2.3	2.3	
Diesel	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
R.R., Vessel, Aircraft	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Sub Total	2.8	2.8	3.1	3.1	3.2	3.3	3.4	3.4	3.2	3.2	3.2	3.2	3
Oxides of Nitrogen													
Auto	24.3	23.7	27.2	27.8	29.5	30.6	31.2	31.2	29.2	29.5	28.6	29.2	
Diesel	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	
R.R., Vessel, Aircraft	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	
Sub Total	29.8	29.2	32.7	33.3	35.4	36.1	36.7	36.7	34.7	35.4	34.1	34.7	34
Organics													
Auto	134.	130.	149.	153.	162.	169.	172.	172.	161.	162.	158.	161.	
Diesel	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	
R.R., Vessel, Aircraft	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	
Sub Total	139.	135.	154.	158.	167.	174.	177.	177.	166.	167.	163.	166.	164
Carbon Monoxide													
Auto	626.	612.	700.	715.	760.	790.	805.	805.	754.	760.	739.	754.	
Diesel	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
R.R., Vessel, Aircraft	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	
Sub Total	628.	614.	702.	717.	762.	792.	807.	807.	756.	762.	741.	756.	745
Benzopyrene*													
Auto	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4*
Particulates													
Auto	2.4	2.3	2.7	2.7	2.9	3.0	3.1	3.1	2.9	2.9	2.8	2.9	
Diesel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
R.R., Vessel, Aircraft	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	
Sub Total	5.4	5.3	5.7	5.7	5.9	6.0	6.1	6.1	5.9	5.9	5.8	5.9	6

*lbs/day

Table A-20

Emissions from Transportation Sources in Philadelphia County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	5.0	4.9	5.6	5.7	6.1	6.3	6.4	6.4	6.0	6.1	5.9	6.0	
Diesel	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
R.R., Vessel, Aircraft	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Sub Total	6.7	6.6	7.3	7.4	7.8	8.0	8.1	8.1	7.7	7.8	7.6	7.7	7.4
Oxides of Nitrogen													
Auto	63.	61.	70.	72.	76.	79.	80.	80.	75.	76.	74.	75.	
Diesel	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	
R.R., Vessel, Aircraft	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	
Sub Total	70.9	68.9	81.9	83.9	87.9	90.9	91.9	91.9	86.9	87.9	85.9	86.9	86
Organics													
Auto	343.	335.	384.	392.	416.	433.	442.	442.	413.	416.	405.	413.	
Diesel	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
R.R., Vessel, Aircraft	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	
Sub Total	355.	347.	396.	404.	428.	445.	454.	454.	425.	428.	417.	425.	415
Carbon Monoxide													
Auto	1620.	1580.	1810.	1840.	1960.	2035.	2075.	2075.	1940.	1960.	1910.	1940.	
Diesel	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
R.R., Vessel, Aircraft	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	
Sub Total	1639.	1599.	1829.	1859.	1979.	2054.	2094.	2094.	1959.	1779.	1729.	1759.	1928
Benzopyrene*													
Auto	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	0.9	0.9	0.9	0.9	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9*
Particulates													
Auto	6.1	6.0	6.9	7.0	7.4	7.7	7.8	7.8	7.3	7.4	7.2	7.3	
Diesel	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
R.R., Vessel, Aircraft	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
Sub Total	14.3	14.2	15.1	15.2	15.6	15.9	16.0	16.0	15.5	15.6	15.4	15.5	16

*lbs/day

Table A-21

Emissions from Transportation Sources in Burlington County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.0	
Diesel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
R.R., Vessel, Aircraft	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Sub Total	1.5	1.5	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.7	1.6
Oxides of Nitrogen													
Auto	10.1	9.8	11.3	11.5	12.2	12.7	12.9	12.9	12.1	12.2	11.8	12.1	
Diesel	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
R.R., Vessel, Aircraft	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
Sub Total	12.2	11.9	13.9	13.6	14.3	14.6	15.0	15.0	14.2	14.3	13.9	14.2	14
Organics													
Auto	55.3	54.0	61.9	63.2	67.0	69.7	71.0	71.0	66.5	67.0	65.2	66.5	
Diesel	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
R.R., Vessel, Aircraft	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
Sub Total	57.0	55.7	63.6	64.9	68.7	71.4	72.7	72.7	68.2	68.7	66.9	68.2	66
Carbon Monoxide													
Auto	259.	253.	290.	296.	314.	317.	333.	333.	311.	314.	305.	311.	
Diesel	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
R.R., Vessel, Aircraft	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
Sub Total	260.	254.	291.	297.	315.	318.	334.	334.	312.	315.	306.	312.	306
Benzopyrene*													
Auto	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2*
Particulates													
Auto	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.2	1.2	1.2	1.2	
Diesel	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
R.R., Vessel, Aircraft	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
Sub Total	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.6	2.6	2.6	2.6	3

*lbs/day

Table A-22

Emissions from Transportation Sources in Camden County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	1.3	1.3	1.4	1.5	1.6	1.6	1.7	1.7	1.6	1.6	1.6	1.6	
Diesel	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
R.R., Vessel, Aircraft	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Sub Total	2.1	2.1	2.2	2.3	2.4	2.4	2.5	2.5	2.4	2.4	2.4	2.4	2.4
Oxides of Nitrogen													
Auto	16.1	15.8	18.0	18.4	19.6	20.4	20.8	20.8	19.4	19.6	19.0	19.4	
Diesel	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
R.R., Vessel, Aircraft	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
Sub Total	18.1	17.8	20.0	20.4	21.6	22.4	22.8	22.8	21.4	21.4	21.0	21.4	21
Organics													
Auto	89.	87.	99.	102.	108.	112.	114.	114.	107.	108.	105.	107.	
Diesel	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
R.R., Vessel, Aircraft	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
Sub Total	90.8	88.8	100.8	103.8	109.8	113.8	115.8	115.8	108.8	109.8	106.8	108.8	107
Carbon Monoxide													
Auto	415.	405.	465.	475.	504.	524.	534.	534.	500.	504.	490.	500.	
Diesel	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
R.R., Vessel, Aircraft	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Sub Total	415.	405.	465.	475.	504.	524.	534.	534.	500.	504.	490.	500.	495
Benzopyrene*													
Auto	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2*
Particulates													
Auto	1.6	1.5	1.8	1.8	1.9	2.0	2.0	2.0	1.9	1.9	1.9	1.9	
Diesel	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
R.R., Vessel, Aircraft	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Sub Total	2.5	2.4	2.7	2.7	2.8	2.9	2.9	2.8	2.8	2.8	2.8	2.8	3

*lbs/day

Table A-23

Emissions from Transportation Sources in Gloucester County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Diesel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
R.R., Vessel, Aircraft	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Sub Total	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Oxides of Nitrogen													
Auto	6.3	6.1	7.0	7.2	7.6	7.9	8.1	8.1	7.5	7.6	7.4	7.5	
Diesel	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
R.R., Vessel, Aircraft	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
Sub Total	7.5	7.3	8.2	8.4	8.8	9.1	9.3	9.3	8.7	8.8	8.6	8.7	9
Organics													
Auto	34.4	33.6	38.4	39.3	41.7	43.5	44.3	44.3	41.4	41.4	40.5	41.4	
Diesel	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
R.R., Vessel, Aircraft	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Sub Total	35.5	34.7	39.5	40.4	42.8	44.6	45.4	45.4	42.5	42.5	41.6	42.5	42
Carbon Monoxide													
Auto	162.	158.	181.	184.	196.	204.	208.	208.	194.	196.	190.	194.	
Diesel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
R.R., Vessel, Aircraft	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Sub Total	162.	158.	181.	184.	196.	204.	208.	208.	194.	196.	190.	194.	195
Benzopyrene*													
Auto	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1*
Particulates													
Auto	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.7	0.7	0.7	
Diesel	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
R.R., Vessel, Aircraft	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
Sub Total	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1

*lbs/day

Table A-24

Emissions from Transportation Sources in Mercer County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	1.0	0.9	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.2	
Diesel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
R.R., Vessel, Aircraft	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Sub Total	1.6	1.5	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.7
Oxides of Nitrogen													
Auto	12.0	11.7	13.4	13.7	14.6	15.1	15.4	15.4	14.4	14.6	14.1	14.4	
Diesel	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
R.R., Vessel, Aircraft	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	
Sub Total	14.5	14.2	15.9	16.2	17.1	17.6	17.9	17.9	16.9	17.1	16.6	16.9	17
Organics													
Auto	66.0	64.5	73.9	75.5	80.0	83.4	85.0	85.0	79.4	80.0	77.8	79.4	
Diesel	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
R.R., Vessel, Aircraft	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	
Sub Total	68.5	67.0	76.4	78.0	82.5	85.9	87.5	87.5	81.9	82.5	70.3	81.1	81
Carbon Monoxide													
Auto	309.	302.	346.	353.	376.	390.	397.	397.	372.	376.	365.	372.	
Diesel	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
R.R., Vessel, Aircraft	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	
Sub Total	313.8	313.8	390.8	357.8	380.8	394.8	401.8	401.8	376.8	380.8	369.8	376.8	380
Benzopyrene*													
Auto	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2*
Particulates													
Auto	1.2	1.1	1.3	1.3	1.4	1.5	1.5	1.5	1.4	1.4	1.4	1.4	
Diesel	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
R.R., Vessel, Aircraft	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	
Sub Total	4.0	2.9	3.1	3.1	3.2	3.3	3.3	3.3	3.2	3.2	3.2	3.2	3

*lbs/day

Table A-25

Emissions from Transportation Sources in Salem County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Diesel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
R.R., Vessel, Aircraft	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	
Sub Total	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Oxides of Nitrogen													
Auto	2.6	2.6	2.9	3.0	3.2	3.3	3.4	3.4	3.1	3.2	3.1	3.1	
Diesel	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
R.R., Vessel, Aircraft	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	
Sub Total	3.3	3.3	3.6	3.7	3.9	4.0	4.1	4.1	3.8	3.9	3.8	3.8	4
Organics													
Auto	14.4	14.0	16.1	16.4	17.4	18.1	18.5	18.5	17.2	17.4	16.9	17.2	
Diesel	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
R.R., Vessel, Aircraft	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Sub Total	15.0	14.6	16.7	17.0	18.0	18.7	19.1	19.1	17.8	18.0	17.5	17.8	18
Carbon Monoxide													
Auto	67.4	65.8	75.4	77.0	81.8	85.0	86.6	86.6	81.0	81.8	79.5	81.0	
Diesel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
R.R., Vessel, Aircraft	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Sub Total	67.6	66.0	75.6	77.2	82.0	85.2	86.8	86.8	81.2	82.0	79.7	81.2	82
Benzopyrene*													
Auto	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates													
Auto	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Diesel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
R.R., Vessel, Aircraft	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Sub Total	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7

*lbs/day

Table A-26

Emissions from Transportation Sources in New Castle County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Auto	1.1	1.1	1.2	1.3	1.4	1.4	1.4	1.4	1.3	1.4	1.3	1.3	
Diesel	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
R.R., Vessel, Aircraft	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	
Sub Total	1.8	1.8	1.9	2.0	2.1	2.1	2.1	2.1	2.0	2.1	2.0	2.0	1.9
Oxides of Nitrogen													
Auto	13.9	13.6	15.6	15.9	16.9	17.6	17.9	17.9	16.7	16.9	16.4	16.7	
Diesel	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
R.R., Vessel, Aircraft	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	
Sub Total	16.2	15.9	17.9	18.2	19.2	19.9	20.2	20.2	19.0	19.2	18.7	19.0	19
Organics													
Auto	76.2	74.4	85.3	87.0	92.5	95.1	98.0	98.0	91.6	92.5	89.9	91.6	
Diesel	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
R.R., Vessel, Aircraft	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
Sub Total	78.6	76.8	87.7	89.8	94.9	97.5	100.4	100.4	94.0	94.9	92.3	94.0	93
Carbon Monoxide													
Auto	351.	343.	394.	402.	427.	444.	453.	453.	422.	427.	414.	422.	
Diesel	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
R.R., Vessel, Aircraft	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	
Sub Total	356.8	348.8	399.8	407.8	432.8	449.8	458.8	458.8	427.8	432.8	419.8	427.8	428
Benzopyrene*													
Auto	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Diesel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
R.R., Vessel, Aircraft	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sub Total	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2*
Particulates													
Auto	1.4	1.3	1.5	1.6	1.6	1.7	1.7	1.7	1.6	1.6	1.6	1.6	
Diesel	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
R.R., Vessel, Aircraft	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	
Sub Total	3.1	3.0	3.2	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3

*lbs/day

Table A-27

Air Pollution Emissions from Transportation Sources -- Tons/Day
Delaware Valley - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	24.9	24.6	26.9	27.2	28.4	28.9	29.4	29.4	28.2	28.4	27.9	28.2	27
Oxides of Nitrogen	231.6	225.6	258.5	263.7	277.7	286.3	290.4	290.8	274.6	280.5	270.3	274.6	272
Organics	1116.7	1091.6	1244.2	1271.2	1346.1	1398.8	1426.0	1421.8	1336.9	1344.2	1302.5	1335.5	1318
Carbon Monoxide	5099.2	4985.6	5741.2	5810.8	6176.6	6406.8	6531.4	6531.4	6116.8	6176.6	6006.3	6116.8	6058
Benzopyrene*	2.5	2.5	2.6	2.6	2.9	3.0	3.1	3.1	2.9	2.9	2.9	2.9	2.9*
Particulates	43.6	42.0	44.9	45.3	46.4	47.5	47.9	47.8	46.5	46.5	46.1	46.4	47

*lbs/day

REFERENCES - APPENDIX A

(1) Motor Gasoline Consumption in the United States for 1965. American Petroleum Institute, Department of Statistics, 1101 Seventeenth Street, N.W., Washington, D.C. 20036.

(2) Approximate Statement of Receipts and Registrations broken down by Counties for 1965. Commonwealth of Pennsylvania, Department of Revenue, Bureau of Motor Vehicles, Harrisburg, Pa.

(3) Passenger Vehicle Counts by Counties in New Jersey. New Jersey Auto Lists, Inc., P. O. Box 813, Trenton, New Jersey 08605.

(4) Classification of Vehicles Registered by Counties for 1965. Motor Vehicle Department, Auditing Department, State of Delaware, Dover, Delaware.

(5) Penn Jersey Transportation Study, Volume I. Delaware Valley Regional Planning Commission, 1317 Filbert Street, Philadelphia, Pa., April 1964.

(6) Comparative Annual Revenue Report for Calendar Years 1964-65. Division of Motor Vehicles, Trenton, New Jersey.

(7) Motor Truck Facts, 1966 Edition. Automobile Manufacturers Assoc., Inc., 320 New Center Building, Detroit, Michigan 48202.

(8) Shipments of Fuel Oil and Kerosene in 1965. Mineral Industry Surveys, U. S. Department of the Interior, Bureau of Mines, Washington 25, D.C., August 9, 1966.

(9) Private Communication. Tax Bureau, New Jersey Public Utilities, Trenton, New Jersey.

(10) Greater Philadelphia Facts, 1966 Edition. Greater Philadelphia Chamber of Commerce, 121 South Broad Street, Philadelphia, Pa. 19107.

(11) Mayer, M. A Compilation of Air Pollutant Emission Factors for Combustion Processes, Gasoline Evaporation and Selected Industrial Processes. U. S. Department of Health, Education, and Welfare, Public Health Service, National Center for Air Pollution Control, Cincinnati, Ohio, May 1965.

(12) Automobile Facts and Figures, 1966 Edition. Automobile Manufacturer's Association, Inc., 320 New Center Building, Detroit, Michigan 48202.

APPENDIX B

EMISSIONS FROM DOMESTIC FUEL CONSUMPTION IN THE DELAWARE VALLEY

I INTRODUCTION

The major air pollution emissions from domestic sources are those from the burning of fuel for home heating, hot water heating, and cooking. For home heating, coal, oil and gas are used; gas and oil are burned for the heating of water; and gas is consumed for cooking. Electricity is also used for each of these purposes by domestic consumers throughout the region. Air pollution emissions from Electric Power Generation are included in Appendix D.

It should be noted that many domestic or household activities that generate air pollution have not been considered in this emission survey. These activities, (which are of minor importance, and are difficult to estimate), include a variety of activities, such as the shaking of a dust mop out-of-doors, the use of aerosol spray cans of all types. The burning of refuse is considered in Appendix F.

II METHODOLOGY

The amount of coal, distillate oil, and natural gas consumed for domestic activities was obtained from public utility companies and from literature references. Heating requirements were calculated in order to estimate the consumption of fuels. The results were checked by comparison with published sales figures whenever possible.

Standard emission factors(1, 2) were used to calculate the weight of pollutants discharged from the amount of each fuel consumed. In applying these factors, the fuel composition shown in Table B-1 was used.

Table B-1

Physical Characteristics of Domestic Fuels(3-5)

Fuel	Heating Value	Sulfur Content	Ash Content
Anthracite Coal	13,000 Btu/lb*	0.6%	11.1%
Distillate Oil #2	150,000 Btu/gal	0.3%	neg
Natural Gas	1,000 Btu/cu ft	neg	neg

*as delivered

III CALCULATIONS

Two procedures were developed for estimating fuel consumption in domestic heaters throughout the Delaware Valley. The Bureau of Census procedure assumes an average energy requirement of 70×10^6 Btu/year/household unit(3) adjusted for degree day. The ASHRAE method bases the fuel consumption upon the actual temperature or degree-days within an area and a unit fuel consumption for each type of heater(6, 7). A degree-day is a unit representing one degree of declination from 65°F in the mean ambient air temperature for one day. For example if the average daily temperature is 50°F, the number of degree days is 65°F - 50°F = 15.

Calculations based upon the ASHRAE method gave a heating requirement of 87×10^6 Btu/year/household unit compared to the lower value of 70×10^6 Btu/year/household unit by the Bureau of Census procedure. Further, a comparison of calculated fuel consumption with available sales data in the Delaware Valley indicated that the ASHRAE method was to be preferred. Consequently, fuel consumption for home heating purposes was calculated by the ASHRAE method.

A. Domestic Heating

Domestic heating units were defined as structures with two or less housing units contained therein. Fuels consumed for larger housing units (apartment houses) are evaluated as commercial sources in Appendix C.

1. Degree - Days

The degree days for the 11 counties in the Delaware Valley are listed in Table B-2(6).

Table B-2

Average Degree Days in Delaware Valley

County	Average Degree Days
Bucks	4695
Chester	4695
Delaware	4695
Montgomery	4695
Philadelphia	4695
Burlington	5068
Camden	4695
Gloucester	4695
Mercer	5068
Salem	5245
New Castle	5245

2. Housing Units

The housing units for the 11 counties in the Delaware Valley are shown in Table B-3(8-10).

Table B-3

Housing Units in Delaware Valley

County	Units Using Gas Heat	Units Using Coal Heat	Units Using Oil Heat
Bucks	9,110	7,430	62,300
Chester	4,830	7,570	37,750
Delaware	49,800	8,590	83,200
Montgomery	34,500	14,900	80,750
Philadelphia	179,800	80,800	230,000
Burlington	14,150	4,910	31,600
Camden	26,900	11,950	64,100
Gloucester	7,070	2,880	25,500
Mercer	16,410	6,680	43,400
Salem	1,430	1,360	12,900
New Castle	15,220	5,780	52,400

3. Emission Factors

The air pollution emissions from domestic home heating were based upon the emission factors given in Table B-4(1-2).

Table B-4

Emission Factors for Domestic Fuel Consumption

Pollutant	Coal Ton/Ton	Oil Ton/MGAL	Gas Ton/MMft^3
(1) Oxides of Sulfur	11.4×10^{-3}	23.5×10^{-3}	0.2×10^{-3}
(2) Oxides of Nitrogen	4×10^{-3}	36×10^{-3}	58×10^{-3}
(3) Organics	7.5×10^{-3}	9.5×10^{-3}	71×10^{-3}
(4) Carbon Monoxide	25×10^{-3}	1×10^{-3}	0.2×10^{-3}
(5) Benzopyrene*	13×10^{-6}	0.10×10^{-6}	0.15×10^{-6}
(6) Particulates	12.5×10^{-3}	6×10^{-3}	9.5×10^{-3}

*Pounds per unit of fuel.

4. ASHRAE Method

The ASHRAE method for estimating fuel consumption for domestic home heating purposes is based upon the formula:

$$F = (U)\,(N_b)\,(D)\,(C_f) \qquad \text{(B-1)}$$

where F= fuel consumption for the estimate period,

U= Unit fuel consumption, or quantity of fuel used per degree-day - building load unit,
D= number of degree days for the estimate period,
Nb= calculated hourly heat loss, in Btuh, and
Cf= outside design temperature correction factor.

As the equation is based upon the specific outside design temperature, C_f for the Delaware Valley was found to be 1.167(6-7).

The unit fuel consumption, U, is a function of the particular fuel used and the "utilization efficiency" of the heating plant:

gas: 0.00000490 therm or 0.00049 cu ft. (1 therm = 100,000 Btu)
oil: 0.00000326 gal, and
coal: 0.00000439 lbs.

The hourly heat loss for the "average" home in the Delaware Valley was based upon a six-room brick house. Using the ASHRAE outline(7), the average hourly heat loss for this area was calculated as 55,000 Btuh, i.e., N_b=55,000.

Table B-5

Summarized Data for Domestic Home Heating Consumption as Calculated by the ASHRAE Method

County	Degree Days	COAL			OIL (2)			GAS (2)		
		Burning Rate(1)	Number of Coal Burning Units	Coal Burned $\frac{\text{Tons}}{\text{Year}}$	Burning Rate(3)	Number of oil Burning Units	Oil Burned $\frac{10^3 \text{ gal}}{\text{Year}}$	Burning Rate(4)	Number of Gas Burning Units	Gas Burned $\frac{10^6 \text{ ft}^3}{\text{Year}}$
Bucks	4695	6.62	7,400	49,000	982.2	62,300	61,200	147,700	9,100	1,350
Chester	4695	6.62	7,600	50,300	982.2	37,800	37,100	147,700	4,800	709
Delaware	4695	6.62	8,600	56,900	982.2	83,200	81,700	147,700	49,800	7,350
Montgomery	4695	6.62	14,900	98,600	982.2	80,800	79,400	147,700	34,500	5,090
Philadelphia	4695	6.62	80,800	534,900	982.2	230,000	225,900	147,700	179,800	26,550
Burlington	5068	7.15	4,900	35,000	1068.	31,600	33,700	159,400	14,200	2,260
Camden	4695	6.62	12,000	79,400	982.2	64,100	63,000	147,700	26,800	3,960
Gloucester	4695	6.62	2,900	[illegible],200	982.2	25,500	25,000	147,700	7,100	1,050
Mercer	5068	7.15	6,700	47,900	1068.	43,400	46,400	159,400	16,400	2,610
Salem	5245	7.40	1,400	10,400	1097.	12,900	14,200	165,000	1,400	231
New Castle	5245	7.40	5,800	42,900	1097.	52,400	57,500	165,000	15,200	2,510
TOTALS	-	-	153,000	1,024,500	-	724,000	725,100	-	359,100	53,670

(1) Burning Rate = 0.00141 x Degree days = Tons per unit per year.
(2) Same Degree days as listed under coal
(3) Burning Rate = 0.2092 x Degree Days = Gallons per unit per year.
(4) Burning Rate = 31.451 x Degree Days = Ft^3 per unit per year.

The annual fuel consumption was calculated as the product of the "unit fuel consumption", U; the "hourly heat loss" N_b; the number of degree days", D; and a "temperature correction factor", C_f: thus,

$$F(\text{gas}) = (0.00049)(55{,}000)(D)(1.67) \text{ or}$$
$$F(\text{gas}) = 31.451\,(D) \text{ cu ft/housing unit,}$$
$$F(\text{oil}) = 0.2092\,(D) \text{ gal/housing unit, and}$$
$$F(\text{coal}) = 0.00141\,(D) \text{ tons/housing unit.}$$

Pertinent data for the ASHRAE method for the calculation of fuels consumed for domestic home heating are presented in Table B-5.

5. Seasonal Variation in Degree Days

The seasonal variation in degree-days for the Delaware Valley (Table B-6) was used to determine monthly air pollution emissions from domestic home heating(6).

Table B-6

Seasonal Variation in Degree Days for the Delaware Valley

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Percent of Yearly Total	20.2	18.2	14.6	8.4	2.1	0	0	0	0.9	5.2	11.6	18.8

B. Domestic Hot Water and Cooking

1. Census of Housing Data

The Census of Housing listed a detailed analysis of hot water heating and cooking statistics for household units in the Delaware Valley (Table B-7). The primary fuels for hot water heating are oil and gas, while gas was the primary fuel for cooking. Coal usage for both categories was negligible. Electric power emissions are shown in Appendix D.

Table B-7

Percentage of Homes with Oil and Gas Hot Water Heating and Cooking

Item	1	2	3	4	5	6	7	8	9	10	11
County	Total Homes With Cooking Equip.	Homes with Gas Cooking	% Homes With Gas Cooking	% of Total Gas Cooking	Total Homes With Hot Water Heating	Homes With Gas H.W.H.	% Homes With Gas H.W.H.	% of Total Gas H.W.H.	Homes With Oil H.W.H.	% Homes With Oil H.W.H.	% of Total Oil H.W.H.
Bucks	83,053	23,600	28.4	2.2	81,383	15,800	19.4	1.9	38,277	47.0	10.8
Chester	55,736	24,400	42.6	2.3	52,557	12,100	23.0	1.5	15,900	30.3	4.5
Delaware	155,858	105,500	68.7	9.7	154,253	84,000	54.3	10.1	39,146	25.4	11.1
Montgomery	146,190	76,000	52.0	7.0	144,454	58,500	40.4	7.0	45,026	31.2	12.9
Philadelphia	611,894	569,000	93.1	52.3	605,935	446,000	73.6	53.6	120,460	19.9	34.0
Burlington	55,110	37,700	68.5	3.5	53,244	32,200	60.5	3.9	10,563	19.8	3.0
Camden	113,540	90,700	80.0	8.4	111,270	76,800	68.9	9.2	22,528	20.2	6.4
Gloucester	38,208	22,030	58.1	2.0	36,271	15,520	42.8	1.9	8,448	23.3	2.4
Mercer	76,078	67,600	88.8	6.2	75,257	42,300	56.2	5.1	26,274	34.9	7.3
Salem	16,640	14,120	84.8	1.3	14,578	2,600	17.8	0.3	3,171	21.8	0.9
New Castle	87,948	55,800	63.4	5.1	86,055	46,000	53.4	5.5	23,516	27.3	6.7
TOTALS	-	1,086,450	-	100.0	-	831,820	-	100.0	353,309	-	100.0

2. Gas Burned for Hot Water and Cooking

Data from the major gas companies in the Delaware Valley tabulated a total domestic gas usage of 85,305 x 10^6 cu ft/year(11).

Based upon a consumption of 53,670 x 10^6 cu ft/yr for domestic home heating (Table B-5), the difference of 31,635 x 10^6 cu ft/year was used for hot water and cooking purposes. A distribution of this usage by counties is given in Table B-8.

Table B-8

Consumption of Oil and Gas for Hot Water and Cooking in the Delaware Valley

County	% of Nonheat Gas (*)	Non-Heat Gas Consumption 10^6 ft^3/yr	% of Gas Heating Consumption	% of Non-Heat Oil (**)	Non-Heat Oil Consumption 10^3 Gal/yr	% of Oil Heating Consumption
Bucks	2.0	626	46.5	10.8	16,400	26.8
Chester	1.9	594	84.0	4.5	6,850	18.5
Delaware	9.9	3,100	42.2	11.1	16,900	20.7
Montgomery	7.0	2,190	43.0	12.9	19,600	24.7
Philadelphia	53.0	16,600	62.5	34.0	51,630	22.8
Burlington	3.7	1,158	51.2	3.0	4,560	13.5
Camden	8.8	2,755	69.6	6.4	9,740	15.4
Gloucester	2.0	626	59.6	2.4	3,650	14.6
Mercer	5.6	1,752	67.2	7.3	11,100	24.0
Salem	0.8	251	108.7	0.9	1,370	9.7
New Castle	5.3	1,660	66.3	6.7	10,200	17.8
TOTALS	100.0	31,635	-	100.0	152,000	-

(*) See Table B-7, Columns 4 and 8

(**) See Table B-7, Column 11

3. Oil Burned for Hot Water

From data in Tables B-5 and B-7, the consumption of oil for hot water and cooking was calculated as follows:

$$\frac{\text{Homes with Oil HWH}}{\text{Homes with Oil Heat}} = \frac{353,309}{724,000} \times 100 = 48.8\%$$

It was assumed that homes which use oil for hot water heating consume 30% of the total gallonage of oil for this purpose. Therefore, 725,100,000 gal/yr (Table B-5), represents 70% of the total oil consumption. For hot water heating the amount would be;

$$725,100,000 \times \frac{0.488}{0.70} \times 0.3 = 152,000,000 \text{ gal/year.}$$

Distribution of oil burned for hot water by counties is given in Table B-8.

IV SUMMARY OF EMISSIONS FROM DOMESTIC FUEL CONSUMPTION

The daily weight of air pollution emissions, by month, for the Delaware Valley for 1965 is presented in Table B-9. The more detailed breakdown by county is shown in Tables B-10 to B-20.

Table B-9

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
Delaware Valley - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	204	185	150	91	30	10	10	10	19	60	121	191	90
Oxides of Nitrogen	220	200	164	103	41	21	21	21	29	72	135	206	112
Organic Compounds	134	122	100	62	23	10	10	10	16	42	81	125	64
Carbon Monoxide	178	160	129	74	19	<1	<1	<1	8	46	102	165	75
Benzopyrene*	180	163	130	75	19	<1	<1	<1	8	47	104	168	76*
Particulates	122	110	89	53	16	3	3	3	9	34	72	114	53

*lbs/day

Table B-10

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
Bucks County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	13.5	12.1	9.7	5.6	1.4	0	0	0	0.6	3.5	7.7	12.5	
Water & Cooking	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
TOTAL	14.6	13.2	10.8	6.7	2.5	1.1	1.1	1.1	1.7	4.6	8.8	13.6	7
Oxides of Nitrogen													
Home Heating	16.6	15.0	12.0	6.9	1.7	0	0	0	0.7	4.3	9.6	15.5	
Water & Cooking	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	
TOTAL	18.3	16.7	13.7	8.6	3.5	1.7	1.7	1.7	2.4	6.0	11.3	17.2	9
Organic Compounds													
Home Heating	7.0	6.4	5.1	2.9	07.	0	0	0	0.3	1.8	4.0	6.5	
Water & Cooking	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
TOTAL	7.6	7.0	5.7	3.5	1.3	0.6	0.6	0.6	0.9	2.4	4.6	7.1	4
Carbon Monoxide													
Home Heating	8.7	7.8	6.3	3.6	0.9	0	0	0	0.4	2.2	5.0	8.0	
Water & Cooking	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
TOTAL	8.8	7.9	6.4	3.7	1.0	0.1	0.1	0.1	0.5	2.3	5.1	8.1	4
Benzopyrene*													
Home Heating	8.7	7.8	6.3	3.6	0.9	0	0	0	0.4	2.2	5.0	8.0	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	8.7	7.8	6.3	3.6	0.9	0	0	0	0.4	2.2	5.0	8.1	4*
Particulates													
Home Heating	6.7	6.0	4.8	2.8	0.7	0	0	0	0.3	1.7	3.8	6.2	
Water & Cooking	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
TOTAL	7.0	6.3	5.1	3.1	1.0	0.3	0.3	0.3	0.6	2.0	4.1	6.5	3

*lbs/day

Table B-11

Air Pollution Emission from Domestic Fuel Consumption -- Tons/Day
Chester County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	9.8	8.8	7.1	4.1	1.0	0	0	0	0.4	2.5	5.6	9.1	
Water & Cooking	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
TOTAL	10.3	9.3	7.6	4.6	1.5	0.5	0.5	0.5	0.9	3.0	6.1	9.6	5
Oxides of Nitrogen													
Home Heating	10.4	9.3	7.5	4.3	1.1	0	0	0	0.5	2.7	6.0	9.7	
Water & Cooking	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
TOTAL	11.2	10.1	8.3	5.1	1.9	0.8	0.8	0.8	1.3	3.5	6.8	10.5	5
Organic Compounds													
Home Heating	5.3	4.7	3.8	2.2	0.5	0	0	0	0.2	1.3	3.0	4.9	
Water & Cooking	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
TOTAL	5.6	5.0	4.1	2.5	0.8	0.3	0.3	0.3	0.5	1.6	3.3	5.2	3
Carbon Monoxide													
Home Heating	8.7	7.8	6.3	3.6	0.9	0	0	0	0.4	2.2	5.0	8.1	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	8.7	7.8	6.3	3.6	0.9	0	0	0	0.4	2.2	5.0	8.1	4
Benzopyrene*													
Home Heating	8.9	8.0	6.4	3.7	0.9	0	0	0	0.4	2.3	5.1	8.2	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	8.9	8.0	6.4	3.7	0.9	0	0	0	0.4	2.3	5.1	8.2	4*
Particulates													
Home Heating	5.8	5.2	4.2	2.4	0.6	0	0	0	0.3	1.5	3.3	5.4	
Water & Cooking	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
TOTAL	5.9	5.3	4.3	2.5	0.7	0.1	0.1	0.1	0.4	1.6	3.4	5.5	3

*lbs/day

Table B-12

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
Delaware County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	17.4	15.6	12.5	7.2	1.8	0	0	0	0.8	4.5	10.0	16.1	
Water & Cooking	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
TOTAL	18.5	16.7	13.6	8.3	2.9	1.1	1.1	1.1	1.9	5.6	11.1	17.1	8
Oxides of Nitrogen													
Home Heating	24.2	21.8	17.5	10.1	2.5	0	0	0	1.1	6.2	13.4	22.5	
Water & Cooking	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	
TOTAL	26.4	24.0	19.7	12.3	4.7	2.2	2.2	2.2	3.3	8.4	15.6	24.7	12
Organic Compounds													
Home Heating	11.6	10.5	8.4	4.8	1.2	0	0	0	0.5	3.0	6.7	10.8	
Water & Cooking	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
TOTAL	12.7	11.6	9.5	5.9	2.3	1.1	1.1	1.1	1.6	4.1	7.8	11.9	6
Carbon Monoxide													
Home Heating	10.1	9.1	7.3	4.2	1.1	0	0	0	0.5	2.6	5.8	9.4	
Water & Cooking	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
TOTAL	10.2	9.2	7.4	4.3	1.2	0.1	0.1	0.1	0.6	2.7	5.9	9.5	4
Benzopyrene*													
Home Heating	10.0	9.1	7.3	4.2	1.1	0	0	0	0.5	2.6	5.8	9.4	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	10.0	9.1	7.3	4.2	1.1	0	0	0	0.5	2.6	5.8	9.4	4*
Particulates													
Home Heating	8.6	7.7	6.2	3.6	0.9	0	0	0	0.4	2.2	4.9	8.0	
Water & Cooking	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
TOTAL	9.0	8.1	6.6	4.0	1.3	0.4	0.4	0.4	0.8	2.6	5.3	8.4	4

*lbs/day

Table B-13

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
Montgomery County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	20.2	18.2	14.6	8.4	2.1	0	0	0	0.9	5.2	11.6	18.8	
Water & Cooking	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	
TOTAL	21.5	19.5	15.9	9.7	3.4	1.3	1.3	1.3	2.2	6.5	12.9	20.1	10
Oxides of Nitrogen													
Home Heating	23.9	21.5	17.3	9.9	2.5	0	0	0	1.1	6.1	13.7	22.2	
Water & Cooking	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	
TOTAL	26.2	23.8	19.6	12.2	4.8	2.3	2.3	2.3	3.4	8.4	16.0	24.5	12
Organic Compounds													
Home Heating	12.5	11.2	6.9	5.2	1.3	0	0	0	0.6	3.2	7.2	11.6	
Water & Cooking	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
TOTAL	13.5	12.2	7.9	6.2	2.3	1.0	1.0	1.0	1.6	4.2	8.2	12.6	6
Carbon Monoxide													
Home Heating	17.1	15.4	12.4	7.1	1.8	0	0	0	0.8	4.4	9.8	15.9	
Water & Cooking	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
TOTAL	17.2	15.5	12.5	7.2	1.9	0.1	0.1	0.1	0.9	4.5	9.9	16.0	7
Benzopyrene*													
Home Heating	17.3	15.6	12.5	7.2	1.8	0	0	0	0.8	4.5	10.0	16.1	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	17.3	15.6	12.5	7.2	1.8	0	0	0	0.8	4.5	10.0	16.1	7*
Particulates													
Home Heating	11.8	10.6	8.5	4.9	1.2	0	0	0	0.5	3.0	6.8	11.0	
Water & Cooking	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
TOTAL	12.2	11.0	8.9	5.3	1.6	0.4	0.4	0.4	0.9	3.4	7.2	11.4	5

*lbs/day

Table B-14

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
Philadelphia County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	77.1	69.4	55.7	32.0	8.0	0	0	0	3.4	19.8	44.3	71.7	
Water & Cooking	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	
TOTAL	80.5	72.8	59.1	35.4	11.4	3.4	3.4	3.4	6.8	23.2	47.7	75.1	35
Oxides of Nitrogen													
Home Heating	79.2	71.4	57.3	33.0	8.2	0	0	0	3.5	20.4	45.5	73.8	
Water & Cooking	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	
TOTAL	87.0	79.2	65.1	40.8	16.0	7.8	7.8	7.8	11.3	28.2	53.3	81.6	40
Organic Compounds													
Home Heating	54.1	48.7	39.1	22.5	5.6	0	0	0	2.4	13.9	31.1	50.3	
Water & Cooking	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	
TOTAL	58.7	53.3	43.7	27.1	10.2	4.6	4.6	4.6	7.0	18.5	35.7	54.9	27
Carbon Monoxide													
Home Heating	91.5	82.5	66.1	38.1	9.5	0	0	0	4.1	23.6	52.5	85.2	
Water & Cooking	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
TOTAL	91.7	82.7	66.3	38.3	9.7	0.2	0.2	0.2	4.3	23.8	52.7	85.4	38
Benzopyrene*													
Home Heating	93.9	84.6	67.8	39.0	9.8	0	0	0	4.2	24.2	53.9	87.3	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	93.9	84.6	67.8	39.0	9.8	0	0	0	4.2	24.2	53.9	87.3	39*
Particulates													
Home Heating	55.7	50.2	40.3	23.2	5.8	0	0	0	2.5	14.4	32.0	51.9	
Water & Cooking	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	
TOTAL	57.0	51.5	41.6	24.5	7.1	1.3	1.3	1.3	3.8	15.7	33.3	53.2	24

*lbs/day

Table B-15

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
Burlington County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	8.1	7.3	5.8	3.4	0.8	0	0	0	0.4	2.1	4.6	7.5	
Water & Cooking	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
TOTAL	8.4	7.6	6.1	3.7	1.1	0.3	0.3	0.3	0.7	2.4	4.9	7.8	4
Oxides of Nitrogen													
Home Heating	10.0	9.0	7.2	4.1	1.0	0	0	0	0.4	2.6	5.7	9.3	
Water & Cooking	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
TOTAL	10.6	9.6	7.8	4.7	1.6	0.6	0.6	0.6	1.0	3.2	6.3	9.9	5
Organic Compounds													
Home Heating	5.0	4.5	3.6	2.1	0.5	0	0	0	0.2	1.3	2.9	4.6	
Water & Cooking	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
TOTAL	5.4	4.9	4.0	2.5	0.9	0.4	0.4	0.4	0.6	1.7	3.3	5.0	3
Carbon Monoxide													
Home Heating	6.1	5.5	4.4	2.5	0.6	0	0	0	0.3	1.6	3.5	5.7	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	6.1	5.5	4.4	2.5	0.6	0	0	0	0.3	1.6	3.5	5.7	3
Benzopyrene*													
Home Heating	6.4	5.7	4.6	2.6	0.7	0	0	0	0.3	1.6	3.7	5.9	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	6.4	5.7	4.6	2.6	0.7	0	0	0	0.3	1.6	3.7	5.9	3*
Particulates													
Home Heating	4.5	4.0	3.2	1.9	0.5	0	0	0	0.2	1.1	2.6	4.1	
Water & Cooking	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
TOTAL	4.6	4.1	3.3	2.0	0.6	0.1	0.1	0.1	0.3	1.2	2.7	4.2	2

*lbs/day

Table B-16

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
Camden County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	16.1	14.6	11.7	6.7	1.7	0	0	0	0.7	4.2	9.3	15.0	
Water & Cooking	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
TOTAL	16.7	15.2	12.3	7.3	2.3	0.6	0.6	0.6	1.3	4.8	9.9	15.6	7
Oxides of Nitrogen													
Home Heating	19.0	17.1	13.7	7.9	2.0	0	0	0	0.8	4.9	10.9	17.6	
Water & Cooking	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	
TOTAL	20.4	18.5	15.1	9.3	3.4	1.4	1.4	1.4	2.2	6.3	12.3	19.0	9
Organic Compounds													
Home Heating	9.9	8.9	7.2	4.1	1.0	0	0	0	0.5	2.6	5.7	9.2	
Water & Cooking	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
TOTAL	10.7	9.7	8.0	4.9	1.8	0.8	0.8	0.8	1.3	3.4	6.5	10.0	5
Carbon Monoxide													
Home Heating	13.8	12.4	10.0	5.7	1.4	0	0	0	0.6	3.5	7.9	12.8	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	13.8	12.4	10.0	5.7	1.4	0	0	0	0.6	3.5	7.9	12.8	6
Benzopyrene*													
Home Heating	14.0	12.6	10.1	5.8	1.5	0	0	0	0.6	3.6	8.0	13.0	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	14.0	12.6	10.1	5.8	1.5	0	0	0	0.6	3.6	8.0	13.0	6*
Particulates													
Home Heating	9.5	8.5	6.9	3.9	1.0	0	0	0	0.4	2.4	5.4	8.8	
Water & Cooking	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
TOTAL	9.7	8.7	7.1	4.1	1.2	0.2	0.2	0.2	0.6	2.6	5.6	9.0	4

*lbs/day

Table B-17

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
Gloucester County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	5.5	4.9	3.9	2.3	0.6	0	0	0	0.2	1.4	3.1	5.1	
Water & Cooking	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
TOTAL	5.7	5.1	4.1	2.5	0.8	0.2	0.2	0.2	0.4	1.6	3.3	5.3	2
Oxides of Nitrogen													
Home Heating	7.0	6.3	5.1	2.9	0.7	0	0	0	0.3	1.8	4.0	6.5	
Water & Cooking	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
TOTAL	7.5	6.8	5.6	3.4	1.2	0.5	0.5	0.5	0.8	2.3	4.5	7.0	3
Organic Compounds													
Home Heating	3.1	2.8	2.2	1.3	0.3	0	0	0	0.1	0.8	1.8	2.9	
Water & Cooking	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
TOTAL	3.3	3.0	2.4	1.5	0.5	0.2	0.2	0.2	0.3	1.0	2.0	3.1	2
Carbon Monoxide													
Home Heating	3.4	3.1	2.5	1.4	0.4	0	0	0	0.2	0.9	2.0	3.2	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	3.5	3.1	2.5	1.4	0.4	0	0	0	0.2	0.9	2.0	3.2	1
Benzopyrene*													
Home Heating	3.4	3.1	2.5	1.4	0.4	0	0	0	0.2	0.9	2.0	3.2	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	3.5	3.1	2.5	1.4	0.4	0	0	0	0.2	0.9	2.0	3.2	1*
Particulates													
Home Heating	2.7	2.4	1.9	1.1	0.3	0	0	0	0.1	0.7	1.5	2.5	
Water & Cooking	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
TOTAL	2.8	2.5	2.0	1.2	0.4	0.1	0.1	0.1	0.2	0.8	1.6	2.6	1

*lbs/day

Table B-18

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
Mercer County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	11.1	10.0	6.4	4.6	1.2	0	0	0	0.5	2.9	6.5	10.6	
Water & Cooking	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
TOTAL	11.9	10.8	7.2	5.4	2.0	0.8	0.8	0.8	1.3	3.7	7.3	11.4	5
Oxides of Nitrogen													
Home Heating	13.9	12.6	10.1	5.6	1.5	0	0	0	0.6	3.6	8.0	13.0	
Water & Cooking	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	
TOTAL	15.3	14.0	11.5	7.0	2.9	1.4	1.4	1.4	2.0	5.0	9.4	14.4	7
Organic Compounds													
Home Heating	6.6	6.0	4.8	2.8	0.7	0	0	0	0.3	1.7	3.8	6.2	
Water & Cooking	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
TOTAL	7.3	6.7	5.5	3.5	1.4	0.7	0.7	0.7	1.0	2.4	4.5	6.9	3
Carbon Monoxide													
Home Heating	8.4	7.5	6.1	3.5	0.9	0	0	0	0.4	2.2	4.8	7.8	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	8.4	7.5	6.1	3.5	0.9	0	0	0	0.4	2.2	4.8	7.8	4
Benzopyrene*													
Home Heating	8.4	7.6	6.1	3.5	0.9	0	0	0	0.4	2.2	4.8	7.8	
Water & Cooking	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
TOTAL	8.5	7.7	6.2	3.6	1.0	0.1	0.1	0.1	0.5	2.3	4.9	7.9	4*
Particulates													
Home Heating	6.1	5.5	4.4	2.5	0.6	0	0	0	0.3	1.6	3.5	5.6	
Water & Cooking	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
TOTAL	6.3	5.7	4.6	2.7	0.8	0.2	0.2	0.2	0.5	1.8	3.7	5.8	3

*lbs/day

Table B-19

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
Salem County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	3.1	2.8	2.2	1.3	0.3	0	0	0	0.1	0.8	1.7	2.9	
Water & Cooking	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
TOTAL	3.2	2.9	2.3	1.4	0.4	0.1	0.1	0.1	0.2	0.9	1.8	3.0	1
Oxides of Nitrogen													
Home Heating	3.8	3.4	2.8	1.7	0.4	0	0	0	0.2	1.0	2.2	3.5	
Water & Cooking	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
TOTAL	4.0	3.6	3.0	1.9	0.6	0.2	0.2	0.2	0.4	1.2	2.4	3.7	2
Organic Compounds													
Home Heating	1.5	1.4	1.1	0.6	0.2	0	0	0	0.1	0.4	0.9	1.4	
Water & Cooking	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
TOTAL	1.6	1.5	1.2	0.7	0.3	0.1	0.1	0.1	0.2	0.5	1.0	1.5	1
Carbon Monoxide													
Home Heating	1.9	1.7	1.3	0.8	0.2	0	0	0	0.1	0.5	1.1	1.7	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	1.9	1.7	1.3	0.8	0.2	0	0	0	0.1	0.5	1.1	1.7	1
Benzopyrene*													
Home Heating	1.9	1.7	1.3	0.8	0.2	0	0	0	0.1	0.5	1.1	1.7	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	1.9	1.7	1.3	0.8	0.2	0	0	0	0.1	0.5	1.1	1.7	1*
Particulates													
Home Heating	1.5	1.3	1.1	0.6	0.2	0	0	0	0.1	0.4	0.8	1.4	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	1.5	1.3	1.1	0.6	0.2	0	0	0	0.1	0.4	0.8	1.4	1

*lbs/day

Table B-20

Air Pollution Emissions from Domestic Fuel Consumption -- Tons/Day
New Castle County - 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Home Heating	12.4	11.2	9.0	5.2	1.3	0	0	0	0.6	3.2	7.1	11.6	
Water & Cooking	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
TOTAL	13.1	11.9	9.7	5.9	2.0	0.7	0.7	0.7	1.3	3.9	7.8	12.3	6
Oxides of Nitrogen													
Home Heating	16.1	14.5	11.6	6.7	1.7	0	0	0	0.7	4.1	9.2	14.9	
Water & Cooking	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	
TOTAL	17.4	15.8	12.9	8.0	3.0	1.3	1.3	1.3	2.0	5.4	10.5	16.2	8
Organic Compounds													
Home Heating	7.0	6.3	5.1	2.9	0.7	0	0	0	0.3	1.8	4.0	6.5	
Water & Cooking	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
TOTAL	7.6	6.9	5.7	3.5	1.3	0.6	0.6	0.6	0.9	2.4	4.6	7.1	4
Carbon Monoxide													
Home Heating	7.6	6.9	5.5	3.2	0.8	0	0	0	0.3	2.0	4.4	7.1	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	7.6	6.9	5.5	3.2	0.8	0	0	0	0.3	2.0	4.4	7.1	3
Benzopyrene*													
Home Heating	7.5	6.8	5.5	3.1	0.8	0	0	0	0.3	1.9	4.3	7.0	
Water & Cooking	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
TOTAL	7.5	6.8	5.5	3.1	0.8	0	0	0	0.3	1.9	4.3	7.0	3*
Particulates													
Home Heating	6.1	5.5	4.4	2.5	0.6	0	0	0	0.3	1.3	3.5	5.7	
Water & Cooking	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
TOTAL	6.3	5.7	4.6	2.7	0.8	0.2	0.2	0.2	0.5	1.5	3.7	5.9	3

*lbs/day

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APPENDIX C

EMISSIONS FROM COMMERCIAL, INSTITUTIONAL AND GOVERNMENTAL FUEL CONSUMPTION IN THE DELAWARE VALLEY

I INTRODUCTION

Air pollution emissions from commercial, institutional, and governmental fuel consumption result from the burning of fuels for space heating purposes. Thousands of individual sources such as retail stores, apartments, governmental offices, military facilities, hospitals, churches, schools and organizational buildings are included in this category.

Because these sources are numerous and widely distributed in the community, precise evaluation is a time consuming task. However, it would be expected that the location of commercial, institutional, and governmental sources would approximate the population trends and residential areas within the Delaware Valley.

II METHODOLOGY

Factual data on which to calculate emissions from commercial, institutional, and governmental fuel consumption are not available. To estimate emissions from these sources, it was decided to use the consumption of domestic fuel as a basis for comparison.

Reliable data on natural gas consumption by commercial establishments were provided by the gas utilities. The total commercial gas consumption for the 11 county area was 12×10^9 cu ft per year(1). This amount was almost 15 percent of the gas consumed by residential sources, and less than 8 percent of the total gas burned in the region.

Based upon questionnaires in the St. Louis area (an area somewhat similar to Philadelphia in the type of fuel burned), Venezia and Ozolins(2) found that commercial, institutional, and governmental establishments could be broken down according to the fuels used: 29% of establishments used coal, 16% used oil, 45% used gas, and 11% used a combination of fuels.

It was also found that the fuels burned by commercial, institutional and governmental sources (referred to hereafter as CIG sources), amounted to less than 10 percent of the total fuel consumed in the St. Louis area. When we compared these results to residential fuel consumption, the CIG fuel use for the St. Louis area averaged 30% of residential consumption for coal; 5% of residential consumption for oil; and 6% of residential consumption for gas.

A similar comparison was made based upon a recent U.S. Public Health Service report on fuels consumed by Federal facilities in the Delaware Valley(3). Comparing the consumption of fuel by Federal facilities to domestic fuel consumption in the Delaware Valley, governmental sources averaged 16% of residential consumption for coal; 5% of residential consumption for oil; and negligible consumption of natural gas.

The relation between residential fuel consumption and CIG fuel use in the Delaware Valley was estimated by evaluating these available data and based upon a general knowledge of the regions' fuel use characteristics. Total consumption for the CIG sources was found to approximate 30 percent of the residential coal usage; 20 percent of the residential oil; and 15 percent of the residential gas consumption.

Different types of fuel will be consumed in CIG sources, as compared to residential, and this will result in different emission rates. Residential coal is primarily anthracite (0.6% S and 11% Ash), while about 70 percent of the CIG coal will be bituminous (2% S and 8% Ash). Similarly, the oil used for residential heating is distillate (0.3% sulfur), but approximately 50% of the CIG fuel oil will be residual (2.4% sulfur).

III CALCULATIONS

Emissions from CIG sources were calculated by applying the derived fuel use pattern to the domestic fuel consumption values given in Appendix B. Each county was considered, and the emission factors were altered to account for differences in sulfur content between residential and CIG fuels.

As a general average for the region, sulfur dioxide emissions from CIG sources amount to 75% of the residential sulfur dioxide emissions. For the remaining pollutants, CIG sources release about 25% of the residential emission rate.

IV SUMMARY OF AIR POLLUTION EMISSIONS FROM CIG FUEL CONSUMPTION IN THE DELAWARE VALLEY

The daily weight of pollutant emissions from CIG fuel consumption by counties for months of the year is shown in Tables C-1 to C-11. Table C-12 summarizes the emission data for the Delaware Valley.

Table C-1

Emissions from Commercial, Governmental, and Institutional Fuel Consumption in Bucks County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	10.9	9.9	8.1	5.0	1.9	0.8	0.8	0.8	1.3	3.5	6.6	10.2	5.3
Oxides of Nitrogen	4.6	4.2	3.4	2.2	0.9	0.4	0.4	0.4	0.6	1.5	2.8	4.3	2.3
Organics	1.9	1.8	1.4	0.9	0.3	0.2	0.2	0.2	0.2	0.6	1.2	1.8	1.0
Carbon Monoxide	2.2	2.0	1.6	0.9	0.3	<0.1	<0.1	<0.1	0.1	0.6	1.3	2.0	1.0
Benzopyrene*	2.2	2.0	1.6	0.9	0.2	0	0	0	0.1	0.6	1.3	2.0	1.0*
Particulates	1.8	1.6	1.3	0.8	0.3	0.1	0.1	0.1	0.2	0.5	1.0	1.6	0.8

*lbs/day

Table C-2

Emissions from Commercial, Governmental, and Institutional Fuel Consumption in Chester County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	7.7	7.0	5.7	3.5	1.1	0.4	0.4	0.4	0.7	2.3	4.6	7.2	3.8
Oxides of Nitrogen	2.8	2.5	2.1	1.3	0.5	0.2	0.2	0.2	0.3	0.9	1.7	2.6	1.3
Organics	1.4	1.3	1.0	0.6	0.2	0.1	0.1	0.1	0.1	0.4	0.8	1.3	1.0
Carbon Monoxide	2.2	2.0	1.6	0.9	0.2	0	0	0	0.1	0.6	1.3	2.0	1
Benzopyrene*	2.2	2.0	1.6	0.9	0.2	0	0	0	0.1	0.6	1.3	2.1	1*
Particulates	1.5	1.3	1.1	0.6	0.2	<0.1	<0.1	<0.1	0.1	0.4	0.9	1.4	0.8

*lbs/day

Table C-3

Emissions from Commercial, Governmental, and Institutional Fuel Consumption in Delaware County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	13.9	12.5	10.2	6.2	2.2	0.8	0.8	0.8	1.4	4.2	8.3	12.8	6
Oxides of Nitrogen	6.6	6.0	4.9	3.1	1.2	0.6	0.6	0.6	0.8	2.1	3.9	6.2	3
Organics	3.2	2.9	2.4	1.5	0.6	0.3	0.3	0.3	0.4	1.0	2.0	3.0	1.5
Carbon Monoxide	2.6	2.3	1.9	1.1	0.3	<0.1	<0.1	<0.1	0.2	0.7	1.5	2.4	1
Benzopyrene*	2.5	2.3	1.8	1.1	0.3	0	0	0	0.1	0.7	1.5	2.4	1*
Particulates	2.3	2.0	1.7	1.0	0.3	0.1	0.1	0.1	0.2	0.7	1.3	2.1	1

*lbs/day

Table C-4

Emissions from Commercial, Governmental, and Institutional Fuel Consumption in Montgomery County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	16.1	14.6	11.9	7.3	2.6	1.0	1.0	1.0	1.7	4.9	9.7	15.1	7.5
Oxides of Nitrogen	6.6	6.0	4.9	3.1	1.2	0.6	0.6	0.6	0.9	2.1	4.0	6.1	3
Organics	3.4	3.1	2.0	1.6	0.6	0.3	0.3	0.3	0.4	1.1	2.1	3.2	1.5
Carbon Monoxide	4.3	3.9	3.1	1.8	0.5	<0.1	<0.1	<0.1	0.2	1.1	2.5	4.0	1.8
Benzopyrene*	4.3	3.9	3.1	1.8	0.5	0	0	0	0.2	1.1	2.5	4.0	1.8*
Particulates	3.1	2.8	2.2	1.3	0.4	0.1	0.1	0.1	0.2	0.9	1.8	2.9	1.3

*lbs/day

Table C-5

Emissions from Commercial, Governmental, and Institutional Fuel Consumption in Philadelphia County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	60.4	54.6	44.3	26.6	8.6	2.6	2.6	2.6	5.1	17.4	35.8	56.3	25.3
Oxides of Nitrogen	21.8	19.8	16.3	10.2	4.0	2.0	2.0	2.0	2.8	7.1	13.3	20.4	10
Organics	14.7	13.3	10.9	6.8	2.6	1.2	1.2	1.2	1.8	4.6	8.9	13.7	7
Carbon Monoxide	22.9	20.7	16.6	9.6	2.4	0.1	0.1	0.1	1.1	6.0	13.2	21.4	10
Benzopyrene*	23.5	21.2	17.0	9.8	2.5	0	0	0	1.1	6.1	13.5	21.8	10*
Particulates	14.3	12.9	10.4	6.1	1.8	0.3	0.3	0.3	1.0	3.9	8.3	13.3	6

*lbs/day

Table C-6

Emissions from Commercial, Governmental, and Institutional Fuel Consumption in Burlington County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	6.3	5.7	4.6	2.8	0.8	0.2	0.2	0.2	0.5	1.8	3.7	5.9	3
Oxides of Nitrogen	2.7	2.4	2.0	1.2	0.4	0.2	0.2	0.2	0.3	0.8	1.6	2.5	1.2
Organics	1.4	1.2	1.0	0.6	0.2	0.1	0.1	0.1	0.2	0.4	0.8	1.3	0.8
Carbon Monoxide	1.5	1.4	1.1	0.6	0.2	0	0	0	0.1	0.4	0.9	1.4	0.8
Benzopyrene*	1.6	1.4	1.2	0.7	0.2	0	0	0	0.1	0.4	0.9	1.5	0.8*
Particulates	1.2	1.0	0.8	0.5	0.2	<0.1	<0.1	<0.1	0.1	0.3	0.7	1.1	0.5

*lbs/day

Table C-7

Emissions from Commercial, Governmental, and Institutional Fuel Consumption in Camden County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	12.5	11.4	9.2	5.5	1.7	0.5	0.5	0.5	1.0	3.6	7.4	11.7	5.3
Oxides of Nitrogen	5.1	4.6	3.8	2.3	0.9	0.4	0.4	0.4	0.6	1.6	3.1	4.8	2.3
Organics	2.7	2.4	2.0	1.2	0.5	0.2	0.2	0.2	0.3	0.9	1.6	2.5	1.3
Carbon Monoxide	3.5	3.1	2.5	1.4	0.4	0	0	0	0.2	0.9	2.0	3.2	1.3
Benzopyrene*	3.5	3.2	2.5	1.5	0.4	0	0	0	0.2	0.9	2.0	3.3	1.3*
Particulates	2.4	2.2	1.8	1.0	0.3	0.1	0.1	0.1	0.2	0.7	1.4	2.3	1.0

*lbs/day

Table C-8

Emissions from Commercial, Governmental, and Institutional Fuel Consumption in Gloucester County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	4.3	3.8	3.1	1.9	0.6	0.2	0.2	0.2	0.3	1.2	2.5	4.0	1.5
Oxides of Nitrogen	1.9	1.7	1.4	0.9	0.3	0.1	0.1	0.1	0.2	0.6	1.1	1.8	0.8
Organics	0.8	0.8	0.6	0.4	0.1	0.1	0.1	0.1	0.1	0.3	0.5	0.8	0.5
Carbon Monoxide	0.9	0.8	0.6	0.4	0.1	0	0	0	0.1	0.2	0.5	0.8	0.3
Benzopyrene*	0.9	0.8	0.6	0.4	0.1	0	0	0	0.1	0.2	0.5	0.8	0.3*
Particulates	0.7	0.6	0.5	0.3	0.1	<0.1	<0.1	<0.1	0.1	0.2	0.4	0.7	0.3

*lbs/day

Table C-9

Emissions from Commercial, Governmental, and Institutional Fuel Consumption in Mercer County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	8.9	8.1	5.4	4.1	1.5	0.6	0.6	0.6	1.0	2.8	5.5	8.6	3.8
Oxides of Nitrogen	3.8	3.5	2.9	1.8	0.7	0.4	0.4	0.4	0.5	1.3	2.4	3.6	1.8
Organics	1.8	1.7	1.4	0.9	0.4	0.2	0.2	0.2	0.3	0.6	1.1	1.7	0.8
Carbon Monoxide	2.1	1.9	1.5	0.9	0.2	0	0	0	0.1	0.6	1.2	2.0	1
Benzopyrene*	2.1	1.9	1.6	0.9	0.3	<0.1	<0.1	<0.1	0.1	0.6	1.2	2.0	1*
Particulates	1.6	1.4	1.2	0.7	0.2	0.1	0.1	0.1	0.1	0.5	0.9	1.5	0.8

*lbs/day

Table C-10

Emissions from Commercial, Governmental, and Institutional Fuel Consumption in Sales County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	2.4	2.2	1.7	1.1	0.3	0.1	0.1	0.1	0.2	0.7	1.4	2.3	0.8
Oxides of Nitrogen	1.0	0.9	0.8	0.5	0.2	0.1	0.1	0.1	0.1	0.3	0.6	0.9	0.5
Organics	0.4	0.4	0.3	0.2	0.1	<0.1	<0.1	<0.1	0.1	0.1	0.3	0.4	0.3
Carbon Monoxide	0.5	0.4	0.3	0.2	0.1	0	0	0	<0.1	0.1	0.3	0.4	0.3
Benzopyrene*	0.5	0.4	0.3	0.2	0.1	0	0	0	<0.1	0.1	0.3	0.4	0.3*
Particulates	0.4	0.3	0.3	0.2	0.1	0	0	0	<0.1	0.1	0.2	0.4	0.3

*lbs/day

Table C-11

Emission from Commercial, Governmental, and Institutional Fuel Consumption in New Castle County, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	9.8	8.9	7.3	4.4	1.5	0.5	0.5	0.5	1.0	2.9	5.9	9.2	4.5
Oxides of Nitrogen	4.4	4.0	3.2	2.0	0.8	0.3	0.3	0.3	0.5	1.4	2.6	4.1	2
Organics	1.9	1.7	1.4	0.9	0.3	0.2	0.2	0.2	0.2	0.6	1.2	1.8	1
Carbon Monoxide	1.9	1.7	1.4	0.8	0.2	0	0	0	0.1	0.5	1.1	1.8	0.8
Benzopyrene*	1.9	1.7	1.4	0.8	0.2	0	0	0	0.1	0.5	1.1	1.8	0.8*
Particulates	1.6	1.4	1.2	0.7	0.2	0.1	0.1	0.1	0.1	0.4	0.9	1.5	0.8

*lbs/day

Table C-12

Emission from Commercial, Governmental, and Institutional Fuel Consumption in Delaware Valley, 1965 -- Tons/Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	153	139	113	68	23	16	16	16	14	45	91	143	67
Oxides of Nitrogen	55	50	41	26	10	5	5	5	7	18	34	52	28
Organics	34	31	25	16	6	3	3	3	4	11	20	31	18
Carbon Monoxide	44	40	32	19	5	<1	<1	<1	2	12	26	41	18
Benzopyrene*	45	41	32	19	5	<1	<1	<1	2	12	26	42	19*
Particulates	31	28	22	13	4	1	1	1	2	9	18	28	13

*lbs/day

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APPENDIX D

AIR POLLUTION EMISSIONS FROM ELECTRICAL POWER GENERATION PLANTS IN THE DELAWARE VALLEY

I INTRODUCTION

A large amount of electrical power is necessary to support mechanized and urbanized activities throughout the Delaware Valley. Electrical power is generated from the burning of fossil fuels, which results in the release of products of combustion as gases and solids to the atmosphere. The amount of pollution from this activity has increased concurrently with the growth in man's standard of living, his desire for more goods and services, and the greater use of labor saving devices. It is expected that additional demands for electricity in the future will result in an even greater atmospheric pollution burden. The extent to which this trend will be abated is dependent upon future changes in the type of fuels burned, the application of air pollution controls to present and future plants and the development of atomic energy or other "non polluting" types of power generating systems.

II METHODOLOGY

There are eight major electric company systems that service the eleven county area(1-3). These systems are shown in Figure D-2. In addition, three communities in Pennsylvania operate local power systems. Specific generating plants are itemized in Table D-1. Their location throughout the Delaware Valley is shown in Figure D-1.

Preliminary estimates of emissions from electrical power generating plants were based upon published fuel consumption at each plant, an average sulfur and ash content of the fuels used and published emission factors(4-7).

To provide more accurate data each electric company within the Delaware Valley was contacted and requested to supply information on fuel composition, monthly fuel usage, and air pollution abatement equipment performance.

All companies responded to the request. In several instances, a company also supplied stack test results for comparison with calculated emission rates. Data presented in this appendix are based upon the information supplied by the power companies.

It should be noted that these data were prepared for 1965. Since that time there has been a reduction in emissions from electrical power generating stations because of a variety of reasons: a change to a lower sulfur and ash content fuels, the installation of pollutant abatement devices, the partial shutdown of older plants, and even the purchase of power from locations outside the area. On the other hand, the consumption of power by industry and public has increased. A greater consumption of electricity means a greater emission of pollutants. These two opposing factors tend to compensate for each other.

Table D-1

Electrical Power Generating Plants in the Delaware Valley

Plant Number*	County	Plant	Company-System
1	Bucks	Quakertown	Borough of Quakertown
2	Chester	Cromby	Philadelphia Electric Co.
3	Delaware	Eddystone	Philadelphia Electric Co.
4	Delaware	Chester	Philadelphia Electric Co.
5	Montgomery	Barbadoes	Philadelphia Electric Co.
6	Montgomery	Hatfield	Borough of Hatfield
7	Montgomery	Lansdale	Borough of Lansdale
8	Philadelphia	Richmond	Philadelphia Electric Co.
9	Philadelphia	Delaware	Philadelphia Electric Co.
10	Philadelphia	Southwark	Philadelphia Electric Co.
11	Philadelphia	Schuylkill	Philadelphia Electric Co.
12	Philadelphia	Edison**	Philadelphia Electric Co.
13	Philadelphia	Willow**	Philadelphia Electric Co.
14	Burlington	Burlington	Public Service Electric and Gas Co.
15	Gloucester	Greenwich	Atlantic City Electric Co.
16	Mercer	Mercer	Public Service Electric and Gas Co.
17	Salem	Deepwater	Atlantic City Electric Co.
18	New Castle	Edge Moor	Delmarva Power and Light Co.
19	New Castle	Delaware City	Delmarva Power and Light Co.

* See Figure D-2 for approximate location.

** For stand-by and steam heat.

Figure D-1

Location Of Electric Power Generating Stations
In The Delaware Valley

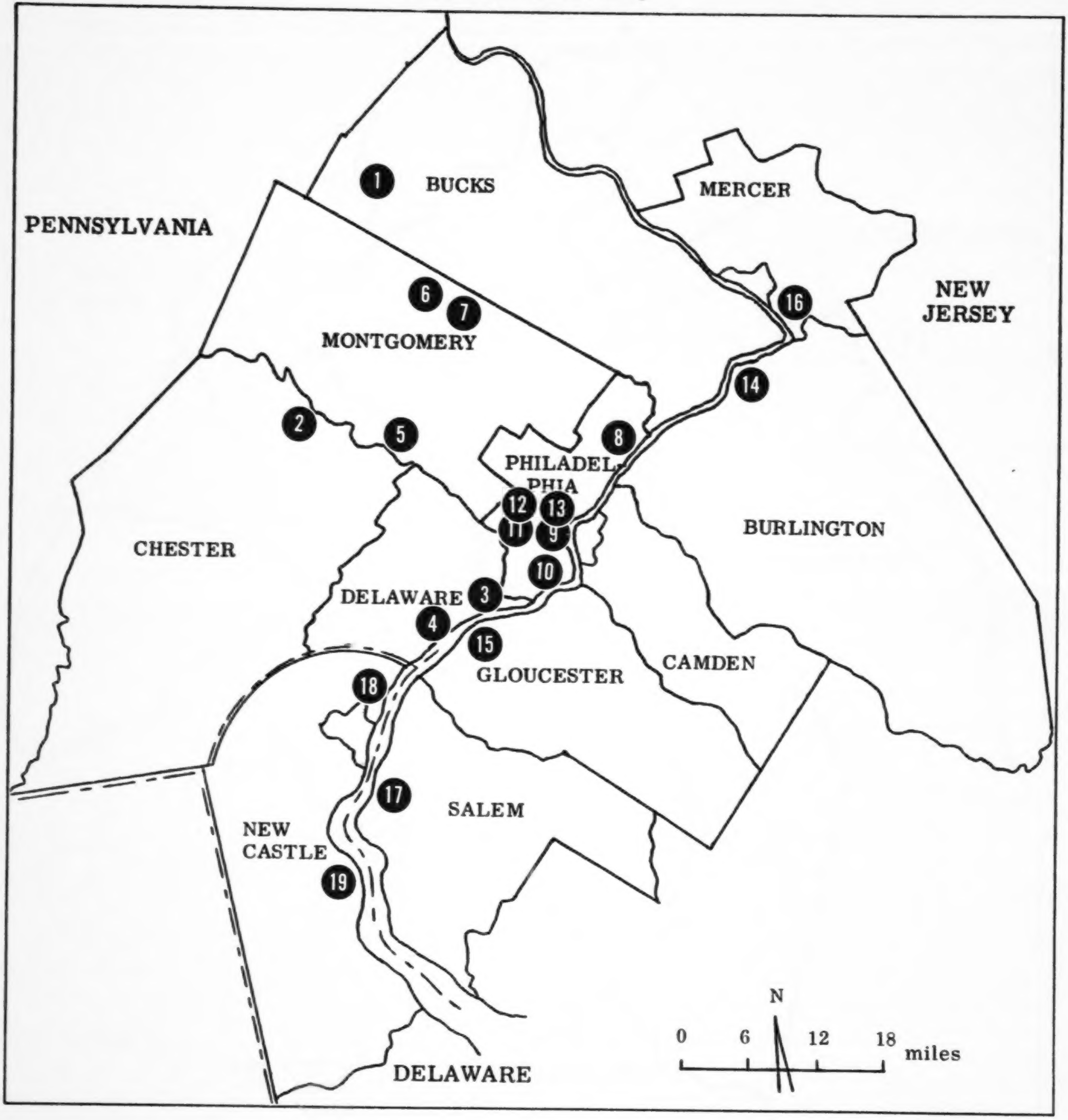
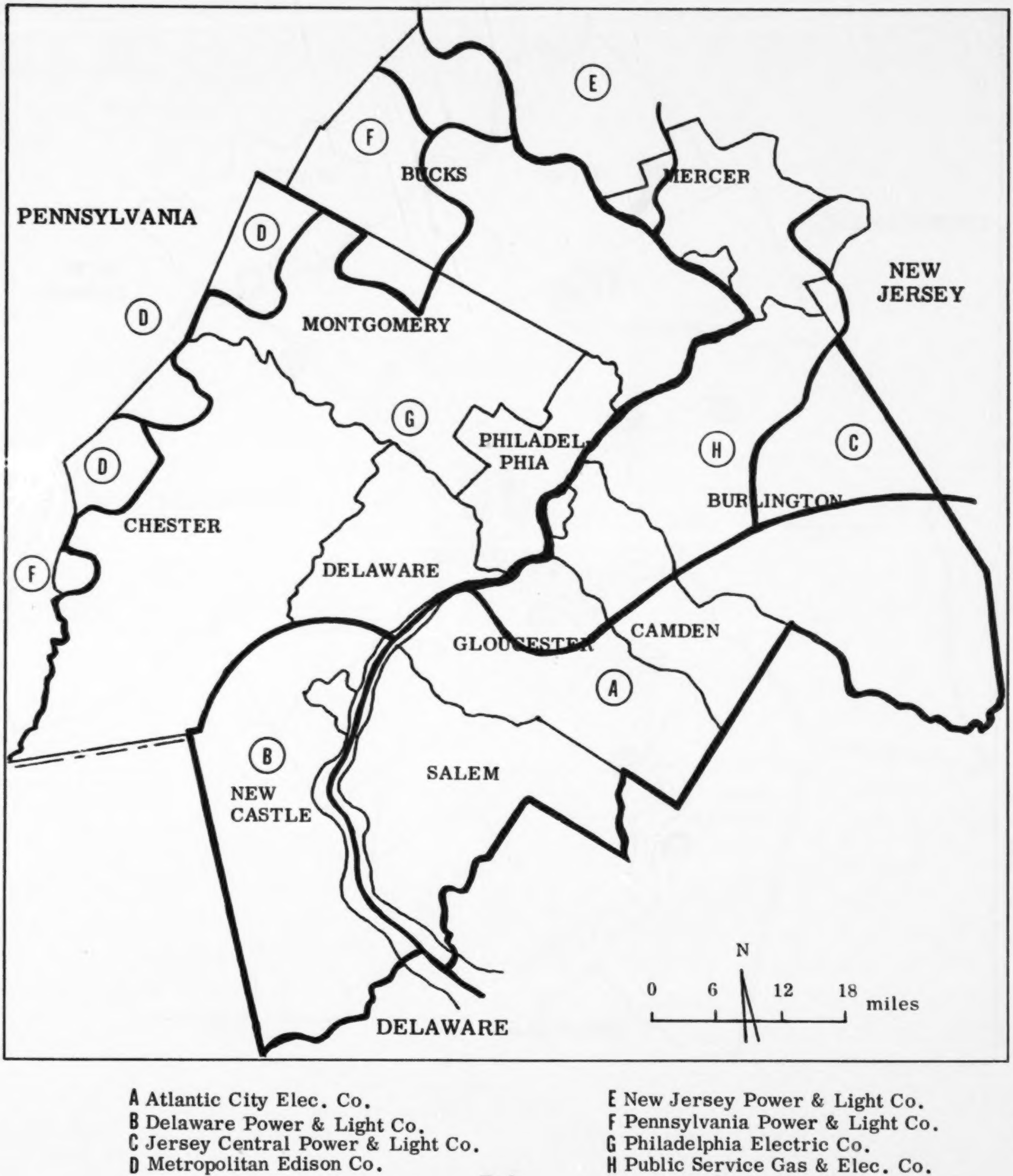


Figure D-2

Service Areas-Major Electric Company Systems



A Atlantic City Elec. Co.
B Delaware Power & Light Co.
C Jersey Central Power & Light Co.
D Metropolitan Edison Co.
E New Jersey Power & Light Co.
F Pennsylvania Power & Light Co.
G Philadelphia Electric Co.
H Public Service Gas & Elec. Co.

Table D-2

Fuel Consumed for Electrical Power Generation in Delaware Valley

County	Coal			Oil			Gas
	Used 10^3 Tons/year	% Sulfur (Range)	% Ash (Range)	Used 10^3 Gal/year	% Sulfur (Range)	Grade Oil	Used 10^6 cu ft/year
Bucks	16.	0.6-2.0	4.7-16.0	118.	0.3	2	40.
Chester	852.	2.4	7.1	184.	2.0	6	-(a)
Delaware	1,856.	1.2-2.2	6.9-8.6	6,850.	2.0	6	-
Montgomery	241.	2.3	6.9	3,340.	0.05-2.0	1, 2, 6	-
Philadelphia	1,982.	1.1-2.2	6.9-8.1	192,150.	1.7-2.0	6	-
Burlington	315.	2.1	(b)	85,806.	2.0	6	-
Camden	-	-	-	-	-	-	-
Gloucester	194.	2.3	(b)	69,048.	2.5	2, (c)	-
Mercer	1,359.	2.1	(b)	-	-	-	2,005.
Salem	522.	2.3	(b)	51,542.	2.5	2, 6	-
New Castle	859.	2.3-6.4	(b)	1,495.	0.3-3.5	2, 6	7,982
TOTAL	8,196.	-	-	410,533	-	-	10,027

(a) Dashed line (-) indicates no fuel usage.
(b) Value not reported.
(c) Tar heels burned.

III CALCULATIONS

A. Fuels Used

In the Delaware Valley, coal and oil are the primary fuels for the generation of electrical power. Petroleum refinery by-products are also used as fuel for this purpose. Only a small quantity of natural gas is used for power production. Fuels used for electrical power generation, as obtained from individual companies, are listed by county in Table D-2.

B. Emission Factors

At each generating station it was necessary to make a complete set of emission calculations for each different fuel burned. Monthly fuel burning rates were supplied by each company. Several companies also provided estimates of particulate emission rates based upon stack sampling tests. The sulfur and ash content of the various fuels were stipulated in most cases. Average daily emission rates were calculated on the basis of 30 days per month.

The emission factors in Table D-3 were used for calculating those emissions which were not estimated by the company. In each case, the company's fuel consumption figures were used.

Table D-3

Power Plant Emission Factors(a)

Pollutants	Coal lb/ton	Oil lb/1000 gal	Gas $lb/10^6 ft^3$
Oxides of Sulfur	38S(c)	159S(c)	0.4
Oxides of Nitrogen	20	104	390
Organics	0.2	3.2	- (b)
Carbon Monoxide	0.5	0.04	- (b)
Benzopyrene	- (b)	5,000 ug	- (b)
Particulates	25	8	15

(a) Reference 7
(b) Negligible (-)
(c) S equals percent sulfur

IV SUMMARY OF AIR POLLUTION EMISSIONS FROM ELECTRICAL POWER GENERATING STATIONS IN THE DELAWARE VALLEY

The daily weight of pollutant emissions from power plants by counties for months of the year, is shown in Tables D-4 to D-14. Table D-15 summarizes the emission data for the Delaware Valley.

Table D-4

Air Pollution Emissions from Electrical Power Plants, Tons/Day
Bucks County, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	0.7	0.5	0.7	0.8	0.6	0.8	0.8	0.7	0.5	0.6	0.6	0.8	0.7
Oxides of Nitrogen	0.6	0.5	0.5	0.4	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5
Organic Compounds	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Carbon Monoxide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	0.7	0.5	0.6	0.5	0.5	0.5	0.6	0.6	0.5	0.6	0.6	0.6	0.6

*lbs/day

Table D-5

Air Pollution Emissions from Electrical Power Plants, Tons/Day
Chester County, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	125	119	126	123	112	119	134	137	110	60	59	112	110
Oxides of Nitrogen	27	25	27	26	24	25	29	29	23	13	13	24	23
Organic Compounds	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.2	0.1	0.1	0.2	0.2
Carbon Monoxide	0.7	0.6	0.7	0.7	0.6	0.6	0.7	0.7	0.6	0.4	0.3	0.6	0.6
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	1.0	0.9	1.0	0.9	0.9	0.9	1.0	1.1	0.8	0.5	0.5	0.9	0.8

*lbs/day

Table D-6

Air Pollution Emissions from Electrical Power Plants, Tons/Day
Delaware County, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	229	206	186	134	233	230	241	259	245	216	240	225	220
Oxides of Nitrogen	55	49	45	32	55	55	58	62	59	52	58	54	52
Organic Compounds	0.6	0.5	0.5	0.4	0.6	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6
Carbon Monoxide	1.3	1.2	1.1	0.8	1.4	1.4	1.4	1.5	1.4	1.3	1.4	1.3	1.3
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	10.4	8.9	9.6	7.5	10.7	11.5	12.3	13.3	12.4	11.0	12.0	10.9	10.7

*lbs/day

Table D-7

Air Pollution Emissions from Electrical Power Plants, Tons/Day
Montgomery County, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	34	21	24	19	24	32	36	39	36	37	35	35	31
Oxides of Nitrogen	8.0	4.9	5.7	4.4	5.7	7.5	8.5	9.0	8.5	8.6	8.2	8.2	7.0
Organic Compounds	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2
Carbon Monoxide	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	4.1	2.8	3.0	2.6	3.1	3.8	4.3	4.5	4.3	3.4	4.2	4.2	3.8

*lbs/day

Table D-8

Air Pollution Emissions from Electrical Power Plants, Tons/Day
Philadelphia County, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	297	247	285	269	250	300	326	328	318	343	317	311	299
Oxides of Nitrogen	84	67	80	74	66	83	89	91	87	94	89	88	82
Organic Compounds	1.7	1.4	1.5	1.4	1.1	1.6	1.6	1.7	1.6	1.7	1.8	1.8	1.6
Carbon Monoxide	1.2	1.1	1.3	1.1	1.2	1.4	1.5	1.6	1.5	1.6	1.4	1.3	1.4
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	30	26	29	28	26	31	33	33	32	33	31	33	30

*lbs/day

Table D-9

Air Pollution Emissions from Electrical Power Plants, Tons/Day
Burlington County, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	82	69	78	67	68	72	81	89	69	84	61	52	72
Oxides of Nitrogen	24	20	22	18	20	23	23	24	20	24	23	17	21
Organic Compounds	0.6	0.5	0.5	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5
Carbon Monoxide	0.3	0.2	0.3	0.2	0.2	0.2	0.3	0.3	0.2	0.3	0.3	0.1	0.2
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	2.6	2.2	2.7	2.6	1.8	2.2	2.9	3.5	2.0	2.8	1.8	0.9	2.3

*lbs/day

Table D-10

Air Pollution Emissions from Electrical Power Plants, Tons/Day
Gloucester County, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	26	23	26	24	25	20	25	26	26	21	25	26	24
Oxides of Nitrogen	6.0	5.4	6.0	5.5	5.8	4.7	5.8	5.9	5.9	4.9	5.8	5.9	5.6
Organic Compounds	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Carbon Monoxide	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	9.9	8.9	10.1	8.9	9.7	7.6	9.4	9.6	9.4	8.1	9.5	9.6	9.2

*lbs/day

Table D-11

Air Pollution Emissions from Electrical Power Plants, Tons/Day
Mercer County, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	205	179	212	216	136	192	221	253	163	149	203	254	198
Oxides of Nitrogen	39	34	40	44	28	37	42	48	34	32	39	48	38
Organic Compounds	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.5	0.3	0.3	0.4	0.5	0.4
Carbon Monoxide	1.0	0.9	1.0	1.0	0.7	0.9	1.0	1.2	0.8	0.7	1.0	1.2	0.9
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	6.0	5.2	6.2	6.3	4.0	5.6	6.4	7.4	4.7	4.3	5.9	7.4	5.7

*lbs/day

Table D-12

Air Pollution Emissions from Electrical Power Plants, Tons/Day
Salem County, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	103	77	98	71	79	94	90	112	83	97	97	96	91
Oxides of Nitrogen	25	18	24	19	19	22	21	27	20	23	23	23	21
Organic Compounds	0.5	0.3	0.5	0.4	0.4	0.4	0.4	0.6	0.4	0.5	0.5	0.4	0.4
Carbon Monoxide	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	21	17	19	16	17	21	21	21	15	20	19	20	19

*lbs/day

Table D-13

Air Pollution Emissions from Electrical Power Plants, Tons/Day
New Castle County, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	231	215	226	187	170	173	247	224	175	186	202	230	205
Oxides of Nitrogen	31	28	29	25	24	27	31	31	27	27	29	32	28
Organic Compounds	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Carbon Monoxide	0.7	0.7	0.7	0.6	0.5	0.5	0.7	0.6	0.5	0.6	0.6	0.7	0.6
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	21	19	19	16	12	15	16	16	14	12	19	20	16

*lbs/day

Table D-14

Air Pollution Emissions from Electrical Power Plants, Tons/Day
Delaware Valley, 1965

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur	1333	1157	1262	1111	1098	1233	1402	1468	1226	1194	1240	1342	1251
Oxides of Nitrogen	300	252	279	248	248	285	308	327	285	234	289	301	279
Organic Compounds	5	4	4	4	4	5	5	5	4	5	5	5	4
Carbon Monoxide	6	5	6	5	5	6	6	8	6	6	6	6	5
Benzopyrene*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	107	91	100	89	86	109	107	110	95	96	104	108	99
Totals	1751	1509	1651	1457	1441	1638	1828	1918	1616	1535	1644	1762	1638

*lbs/day

REFERENCES - APPENDIX D

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(4) Steam Electric Plant Factors-1965. National Coal Association, 1130 Seventeenth Street, N.W. Washington, D.C. October, 1966.

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APPENDIX E

EMISSIONS FROM INDUSTRIAL FUEL CONSUMPTION AND PROCESSING

I INTRODUCTION

Emissions from industrial operations depend upon many diverse factors including the type of operation, the production capacity, the age of the plant, the type of fuel used and the air pollution control equipment.

In addition to the very large number of different sizes and types of industrial units, the plants are widely scattered throughout the region.

In previous source surveys, industrial emissions have been calculated only for a few large operations in the area of concern. Pollutant emissions from the small or medium sized operations were neglected because of the difficulties of interrelating the diversity of sources and other factors.

Despite the paucity of data, a procedure has been devised to calculate emissions from industrial manufacturing sources. The method is based upon data on fuels used by the source categories listed in the Standard Industrial Classifications. These data are available for Standard Metropolitan Statistical Areas.

It was determined that six of the Standard Industrial Classification categories consumed about 80 per cent of the total daily industrial energy. By evaluating emissions from the fuel consumed by these six categories, and determining processing emissions based upon available data or estimates, it was possible to make an approximation of total emissions from all manufacturing sources.

II METHODOLOGY

An assessment was made of emissions from the major point sources. This was accomplished by contacting the larger industries and requesting information relative to their atmospheric emissions. A total of 135 plants were contacted. The information requested was limited to fuel consumption, process losses or process emission estimates, and refuse incineration practices. Information was supplied by 40 of the 135 sources contacted. The data obtained was an incomplete segment of the total industrial emissions. Therefore, the estimates of total emissions were based upon the knowledge that products of combustion were the prime factors in atmospheric contamination. In the general case, it is assumed that industries which consumed the greatest number of British Thermal Units (Btus) would also emit the greatest weight of air pollutants. In this manner, industrial energy requirements are related to combustion and process emissions. The use of this concept for the calculation of industrial emissions was developed in 1956(1). Based upon this technique, Wohlers found that estimated atmospheric pollution concentrations compared favorably with measured concentrations in seven cities of the United States(2).

The procedure may be best demonstrated by reference to Table E-1. Of the total daily energy requirements for seven cities scattered throughout the United States, at least 78% is consumed by the following six classifications:

Food and Kindred Products (20),
Paper and Allied Products (26),
Chemicals and Allied Products (28),
Petroleum and Coal Products (29),
Stone, Clay and Glass Products (32), and
Primary Metals (33).

If the air pollutant emissions from these industries could be determined, the total industrial emissions could be estimated on a Btu consumed basis.

The U. S. Public Health Service has taken general steps in this direction by publishing emissions from different types of industrial operations(3-11). The New York State Department of Health has estimated particulate matter discharged from nonprocess operations(12-13). Chicago has used a data processing systems to correlate industrial activity with pollutant emission from fuel burning operations; manufacturing process emissions have not yet been added to Chicago's system(14-15).

At present, a "unit of pollution emission" for each of the six Standard Industrial Classifications of concern has not been adequately defined. In the Delaware Valley, these emissions were determined by making a comparison of the industrial questionnaire returns with emission survey results from other areas. In instances where data were not available, engineering judgement was used.

III CALCULATIONS

A. Industrial Fuels Used in Delaware Valley, 1962.

The Delaware Valley is comprised of three Standard Metropolitan Statistical Areas (SMSA) ---- Philadelphia-Camden, Trenton, and Wilmington. The Department of Commerce periodically publishes industrial data according to 20 Standard Industrial Classifications. Table E-2 lists the 1962 purchased fuels for the SMSA's of Philadelphia-Camden, Trenton, and Wilmington(16); data in Table E-2 were augmented with information from the Bureau of Census(17).

B. Industrial Fuels Used in Delaware Valley, 1965

The 1965 total fuel consumption for the Delaware Valley was based upon fuel usage in the region(18) and upon discussions with fuel specialists in the Federal Government(17, 19). The fuels consumed by the 20 SIC groups for 1965 was calculated as a ratio of the data in Table E-2, i.e.

$$\frac{\text{Fuel Consumed 1965}}{\text{Fuel Consumed 1962}} \times \text{1962 SIC Fuel Consumed}$$

The calculated data for SIC groups in 1965 are presented in Table E-3.

C. British Thermal Units Consumed by SIC Groups in 1965

Table E-4 lists the daily Btu consumed by the 20 SIC groups for 1965. It should be noted that the six SIC groups of concern (20, 26, 28, 29, 32 and 33) consume 610.9×10^9 Btu per day or 80 percent of the total Btu consumed by the 20 SIC groups in 1965.

Table E-1

Energy Consumption by Industrial Users in Various Cities--1954
10^9 Btu Consumed Daily

SIC Group	Classification	Los Angeles	Portland (Ore.)	New York	Chicago	San Francisco	Cincinnati	Louisville
20	Food and Kindred Products	135.6	8.4	159.6	245.5	92.0	7.1	35.1
26	Paper and Allied Products	27.6	11.4	115.2	62.5	15.3	13.8	0.2
28	Chemicals and Allied Products	82.6	1.5	177.8	144.8	47.2	26.7	11.9
29	Petroleum and Coal Products	421.8	0.5	17.2	184.5	204.7	6.9	5.8
32	Stone, Clay and Glass Products	191.9	6.0	141.3	184.0	97.1	31.9	14.9
33	Primary Metals	175.1	5.9	700.5	1975.0	85.3	202.7	55.2
TOTAL		1034.6	33.7	1311.6	2796.3	541.6	289.1	123.1
	Total Btu consumed in all SIC Groups (20-39)	1131.9	43.1	1655.1	3120.5	586.4	333.0	144.6
	Percent of total Btu consumed by the 6 largest energy users	91	78	79	90	92	87	85

Table E-2

Purchased Fuels by Manufacturing Industries in the Delaware Valley*--1962

Major Group	Manufacturing Industry Category	Coal 10^3tons	Coke 10^3tons	Fuel Oil, Distillate 10^3 bbl	Fuel Oil, Residual 10^3 bbl	Gas 10^6 cu ft
20	Food and Kindred Products	100(1)	- (2)	181	1,175	6,533
21	Tobacco Mfgrs.	-	-	2(1)	14(1)	-
22	Textile Mill Products	45	-	41	904	500
23	Apparel & Related Products	4	-	43	121	130
24	Lumber & Wood Products	15(1)	-	3(1)	22(1)	200(1)
25	Furniture & Fixtures	10(1)	-	9	57	131
26	Paper & Allied Products	357	-	84	2,292	236
27	Printing & Publishing	15(1)	-	19	98	947
28	Chemicals & Allied Products	420	20(1)	385	3,394	9,565
29	Petroleum & Coal Products	-	-	22(1)	1,137	25,478(1)
30	Rubber & Plastics nec	109	-	83	624	138
31	Leather & Leather Products	5(1)	-	3(1)	174	500(1)
32	Stone, Clay & Glass Products	103	-	476	607	6,635
33	Primary Metal Industry	182	68	315	3,124	26,239
34	Fabricated Metal Products	40	4	304	539	2,620
35	Machinery, exc. Electric	15(1)	4(1)	116	642	1,112
36	Electrical Machinery	10)1)	-	141	486	622
37	Transportation Equipment	10(1)	4(1)	49	483	600(1)
38	Instruments & Rel. Products	10(1)	-	9	105	400(1)
39	Misc. Mfg.	12(1)	-	81	110	414
TOTAL		1,462	100	2,366	16,108	83,000
Philadelphia-Camden		1,330	93	1,920	13,007	75,165
Wilmington		57	4(1)	309	2,111	7,028
Trenton		75	3	137	990	807

(1) Approximate Value
(2) Dashed line represents negligible value
* SMSA of Trenton, Philadelphia-Camden, and Wilmington

Table E-3

Purchased Fuels by Manufacturing Industries in the Delaware Valley*--1965

Major Group	Manufacturing Industry Category	Coal 10^3tons	Coke 10^3tons	Fuel Oil, Distillate 10^3 bbl	Fuel Oil, Residual 10^3 bbl	Gas 10^6 cu ft
20	Food & Kindred Products	101(1)	- (2)	160	1,382	8,309
21	Tobacco Mfgrs.	-	-	2(1)	17(1)	-
22	Textile Mill Products	45	-	36	1,063	636
23	Apparel & Related Products	4	-	38	143	165
24	Lumber & Wood Products	15(1)	-	3(1)	26(1)	254(1)
25	Furniture & Fixtures	10(1)	-	8	67	167
26	Paper & Allied Products	360	-	74	2,696	300
27	Printing & Publishing	15(1)	-	17	115	1,205
28	Chemicals & Allied Products	423	25(1)	341	3,992	12,165
29	Petroleum & Coal Products	-	-	19(1)	1,337	32,404(1)
30	Rubber & Plastics nec	110	-	73	734	176 -
31	Leather & Leather Products	5(1)	-	3(1)	205	636(1)
32	Stone, Clay & Glass Products	104	-	421	714	8,439
33	Primary Metal Industry	183	83	279	3,675	33,372
34	Fabricated Metal Products	40	5	269	634	3,332
35	Machinery, exc. Electric	15(1)	5(1)	103	755	1,414
36	Electrical Machinery	10(1)	-	125	572	791
37	Transportation Equip.	10(1)	5(1)	43	568	763(1)
38	Instruments & Rel. Products	10(1)	-	8	124	509(1)
39	Misc. Mfg.	12(1)	-	72	129	527
	TOTAL	1,472	123	2,094	18,948	105,564
	Philadelphia-Camden	1,340	114	1,700	15,300	95,600
	Wilmington	57	5(1)	273	2,483	8,939
	Trenton	75	4	121	1,165	1,025

(1) Approximate value

(2) Dashed line represents negligible value

* SMSA of Trenton, Philadelphia-Camden, and Wilmington

Table E-4

Daily Energy Consumption for Manufacturing Industries in the Delaware Valley--1965
10^9 Btu Consumed Daily

Major Group	Category	Coal(1)	Coke(1)	Fuel Oil, Distillate(2)	Fuel Oil, Residual(2)	Gas(3)	Total	Sub-total
20	Food & Kindred Products	7.19	-	2.76	23.85	22.68	56.48	56.48
21	Tobacco Mfgrs.	-	-	0.03	0.29	-	0.32	
22	Textile Mill Products	3.21	-	0.62	18.35	1.74	23.92	
23	Apparel & Related Products	0.28	-	0.66	2.47	0.45	3.86	
24	Lumber & Wood Products	1.07	-	0.05	0.45	0.69	2.26	
25	Furniture & Fixtures	0.71	-	0.14	1.16	0.46	2.47	
26	Paper & Allied Products	25.64	-	1.28	46.53	0.82	74.27	74.27
27	Printing & Publishing	1.07	-	0.29	1.98	3.29	6.63	
28	Chemicals & Allied Products	30.13	1.78	5.88	68.91	33.21	139.91	139.91
29	Petroleum & Coal Products	-	-	0.33	23.08	88.46	111.87	111.87
30	Rubber & Plastics nec.	7.84	-	1.26	12.67	0.48	22.25	
31	Leather & Leather Products	0.36	-	0.05	3.54	1.74	5.69	
32	Stone, Clay & Glass Products	7.41	-	7.27	12.32	23.04	50.04	50.04
33	Primary Metal Industry	13.04	5.90	4.82	63.44	91.10	178.30	178.30
34	Fabricated Metal Products	2.85	0.36	4.64	10.94	9.10	27.89	
35	Machinery, exc. Electric	1.07	0.36	1.78	13.03	3.86	20.10	
36	Electrical Machinery	0.71	-	2.16	9.87	2.16	14.90	
37	Transportation Equip.	0.71	0.36	0.74	9.80	2.08	13.69	
38	Instruments & Rel. Prod.	0.71	-	0.14	2.14	1.39	4.38	
39	Misc. Mfg.	0.85	-	1.24	2.23	1.44	5.76	
	TOTAL	104.85	8.76	36.14	327.05	288.19	764.99	610.87
	Philadelphia-Camden	94.45	8.12	29.34	264.08	260.09	657.98	
	Wilmington	4.06	0.36	4.71	42.86	24.40	76.39	
	Trenton	5.34	0.28	2.09	20.11	2.80	30.62	

(1) 26×10^6 Btu/ton
(2) 150,000 Btu/gal
(3) 1000 Btu/cu ft

D. Emission Factors for Delaware Valley Industry

Industrial emission factors for the Delaware Valley are listed in Table E-5. The factors include pollutant emissions from both industrial fuel consumption and process losses; the factors thus account for the type of fuels used (Table E-3), process emissions, and available air pollution control equipment. Use was made of published factors (13, 20) as well as emission data published by the U. S. Public Health Service(3-11). Results from the questionnaires sent to refineries in the Delaware Valley were most helpful in the development of the factors. Included in the organic compound emissions from refineries are those losses from the storage and handling of bulk quantities of petroleum products.

E. Emissions from Industrial Operations in the Delaware Valley

Based upon the emission factors in Table E-5 and the daily energy consumption in Table E-4, the daily pollutant emissions from the six largest energy consuming SIC groups are given in Table E-6.

As the energy consumed by the six major industrial groups (20, 26, 28, 29, 32, and 33) amounted to 80 percent of the total industrial energy consumed in the Delaware Valley in 1965, the emission tonnages in Table E-6 were multiplied by the factor 100/80 to obtain the total industrial emissions for 1965 (Table E-7).

F. Seasonal Variation of Industrial Emissions

It was assumed that the industrial emissions were constant throughout the year. Although it would be expected that emissions from fuel consumption would be greater during the winter months, it was judged that this increase would be offset by the reduction in process emissions because of operational difficulties during the winter months.

G. Geographical Variation of Industrial Emissions

Emissions from industrial operations within each county in the Delaware Valley were calculated based upon employment figures in SIC groups. Employment percentages by SIC groups and counties are presented in Table E-8(21-26).

IV SUMMARY OF AIR POLLUTION EMISSIONS FROM INDUSTRIAL FUEL CONSUMPTION AND PROCESSING IN DELAWARE VALLEY, 1965

Table E-9 shows the daily weight of air pollution emissions from all phases of industrial operations in the Delaware Valley for 1965. As noted, these emissions are assumed constant throughout the year. Data in Table E-9 were calculated from the tons of pollutants emitted from the 6 major SIC groups (Table E-6), the pollutants emitted from the remaining SIC groups (Tables E-7 and E-6), and the percentage of employment in respective groups (Table E-8).

Table E-5

Manufacturing Industry Emission Factors - Delaware Valley - 1965

Tons Pollutants Emitted per 10^9 Btu Consumed Daily

Major Group	Category	SO_x	NO_x	CO	Organics	Particulate	Benzopyrene*
20	Food and Kindred Products	0.81	0.28	0.01	0.20	0.37	1×10^{-4}
26	Paper and Allied Products	1.40	0.39	0.02	0.41	0.95	1×10^{-4}
28	Chemicals and Allied Products	1.16	0.37	0.04	0.35	0.69	1×10^{-4}
29	Petroleum and Coal Products	4.02	0.72	17.5	3.62	0.59	1×10^{-4}
32	Stone, Clay and Glass Products	0.56	0.26	0.02	0.25	0.48	2×10^{-4}
33	Primary Metal Industry	0.74	0.27	0.02	0.20	0.25	1×10^{-4}

* Pounds per day

Table E-6

Industrial Emissions from Major** SIC Groups in the Delaware Valley - 1965

Pollutants Emitted - Tons/Day

Major Group	Category	SO_x	NO_x	CO	Organics	Particulate	Benzopyrene*
20	Food and Kindred Products	46	15	<1	12	21	<0.1
26	Paper and Allied Products	104	29	1	31	70	<0.1
28	Chemicals and Allied Products	162	51	5	49	96	<0.1
29	Petroleum and Coal Products	450	80	1960	405	66	<0.1
32	Stone, Clay and Glass Products	28	13	1	13	24	<0.1
33	Primary Metal Industry	132	48	3	37	45	<0.1
	TOTAL	922	236	1970	547	322	<0.1

Table E-7

Total Industrial Emissions	SO_x	NO_x	CO	Organics	Particulates	Benzopyrene*
- Delaware Valley, 1965 -	1155	294	2460	685	402	<0.1

*Pounds per day
**Represents approx. 80% of total industrial emissions

Table E-8

Percentage Employment for Manufacturing Industries in the Delaware Valley - 1965 by SIC Group and County

SIC Group	Industry	Bucks	Chester	Delaware	Mont-gomery	Phila.	Burling-ton	Camden	Glou-cester	Mercer	Salem	New Castle	Total
20	Food & Kindred Products	2.10%	5.59%	2.74%	8.69%	59.71%	1.36%	10.54%	1.82%	2.67%	1.10%	3.68%	100%
26	Paper & Allied Products	10.28	6.44	14.16	13.30	40.31	1.62	7.47	1.35	3.72	neg.	1.35	100
28	Chemicals & Allied Prod.	7.83	3.17	4.15	11.23	32.48	1.91	3.93	5.68	3.62	16.89	9.11	100
29	Petroleum & Coal Products	0.26	0.26	34.36	2.88	36.30	0.79	5.39	13.66	neg.	neg.	6.10	100
32	Stone, Clay & Glass Prod.	7.13	4.87	1.58	23.05	16.84	1.95	10.20	1.05	21.50	8.68	3.15	100
33	Primary Metals Industry	19.43	15.66	6.40	23.03	13.64	10.44	1.64	0.84	3.45	neg.	5.47	100
	Other SIC Groups Not Listed Above	4.45	3.03	8.96	12.79	44.73	2.55	7.34	1.39	6.47	0.29	8.00	100

Table E-9

Air Pollution Emissions from Industrial Sources in the Delaware Valley, 1965--Tons/Day

Pollutant	Bucks	Chester	Del.	Mont.	Phila.	Burlington	Camden	Gloucester	Mercer	Salem	New Castle	Total
Oxides of Sulfur	64	45	208	115	412	29	66	79	36	31	70	1155
Oxides of Nitrogen	18	14	43	35	102	9	17	16	12	10	18	294
Organics	23	16	161	52	251	13	39	61	16	10	43	685
Carbon Monoxide	27	19	720	120	933	28	142	276	33	2	160	2460
Benzopyrene(*)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	29	20	48	50	140	11	24	18	19	19	24	402
Total	161	114	1180	372	1838	90	288	450	116	72	315	4996

(*) lbs. per day

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APPENDIX F

EMISSIONS FROM REFUSE INCINERATION IN THE DELAWARE VALLEY

I INTRODUCTION

The burning of refuse in open dumps is prohibited by law in the States of Pennsylvania and New Jersey. Although some open burning is practiced in New Castle County, the State of Delaware is presently developing air pollution control regulations.

In the Delaware Valley, refuse is burned in industrial, commercial and municipal incinerators. Small quantities of refuse are also burned in domestic units. Sanitary landfills are used to bury raw refuse as well as most of the residue which results from incineration. Landfill sites, which probably number over one hundred, are scattered throughout the region. Fires occur periodically at some of these locations, but no estimate has been made of emissions from the source of open burning.

II METHODOLOGY

A comprehensive study of refuse disposal practices is being completed by the State Health Departments in conjunction with the Delaware Valley Regional Planning Commission and the Federal Government. Unfortunately, a complete analysis of these data were not available for the present study.

In order to obtain information on refuse burning throughout the Delaware Valley, contacts were made with personnel in State and Local Health Departments. Major industries were also requested to provide information on their refuse disposal practices. A production of 4 lbs. per capita per day of combustible material was used to estimate refuse generation by all sources. Emission factors were applied to the tonnages of refuse burned.

The methodology for the calculation of emission of pollutants from refuse disposal is outlined below:

a. Estimate total refuse generated in study area based upon population and an assumed per capita refuse generation.

b. By inquiry, determine the amount of refuse handled in municipal incinerators.

c. Determine amount of refuse handled in landfill operations or estimate this amount based upon available data.

d. By difference, the amount not in categories (b) and (c) is assumed to be incinerated or burned throughout the area on industrial, commercial, or domestic property.

e. Apply emission factors to calculate pollutant emissions from incineration.

III CALCULATIONS

A. Population and Refuse Produced

Population figures for the eleven counties were obtained from the Philadelphia Chamber of Commerce(1). Population values were multiplied by 4 lbs. per capita per day for the total weight of combustible refuse produced in the Delaware Valley. Table F-1 lists both population and refuse totals.

A list of municipal incinerators in the Delaware Valley is presented in Table F-2 and their location is shown in Figure F-1.

B. Weight of Refuse Disposal by Various Methods

A summary of the estimated weight of refuse disposal by alternate methods in the 11 counties is given in Table F-3.

For Bucks, Chester, Camden, Gloucester, Salem and New Castle Counties, no refuse was burned in municipal incinerators. From available data it was assumed that 10% of the refuse generated in Bucks and Chester Counties was burned in domestic incinerators; fifteen percent was burned in industrial or commercial incinerators. For Camden, Gloucester, Salem and New Castle Counties, it was estimated that 10% of the refuse was burned in domestic and 10% in industrial-commercial incinerators.

For Philadelphia County it was assumed that negligible quantities of refuse were burned in domestic incinerators. Municipal incinerators in Philadelphia burned approximately 3,000 tons refuse per day. By subtraction, 1,094 tons of refuse were consumed in industrial-commercial incinerators.

For Delaware and Montgomery Counties, municipal incinerators burned 710 and 240 tons of refuse per day respectively. It was assumed that for these counties, 10% of the refuse was consumed in domestic and 15% in industrial-commercial incinerators.

In Burlington and Mercer Counties, municipal incineration accounted for 50 and 470 tons/day of refuse disposed. It was assumed that 10% of the generated refuse was burned in both domestic and industrial-commercial incinerators.

C. Emission Factors

Emission factors for determining the weight of air pollutants discharged from the burning of refuse are presented in Table F-4(2).

IV SUMMARY OF AIR POLLUTION EMISSIONS FROM REFUSE INCINERATION IN DELAWARE VALLEY

The daily weight of air pollution emissions from refuse incineration in Delaware Valley for 1965 is presented in Table F-5. Refuse incineration emissions are assumed constant throughout the year.

Table F-1

Population and Combustible Refuse for Delaware Valley, 1965

County	Population 1965 in Thousands	Tons/day of Combustible refuse @ 4 lbs/Capita
Bucks	345	690
Chester	246	492
Delaware	589	1,178
Montgomery	586	1,172
Philadelphia	2,047	4,094
Burlington	273	546
Camden	429	858
Gloucester	151	302
Mercer	293	586
Salem	64	128
New Castle	338	676
Total	5,361	10,722

Figure F-1

Major Refuse Incinerators In The Delaware Valley - 1965

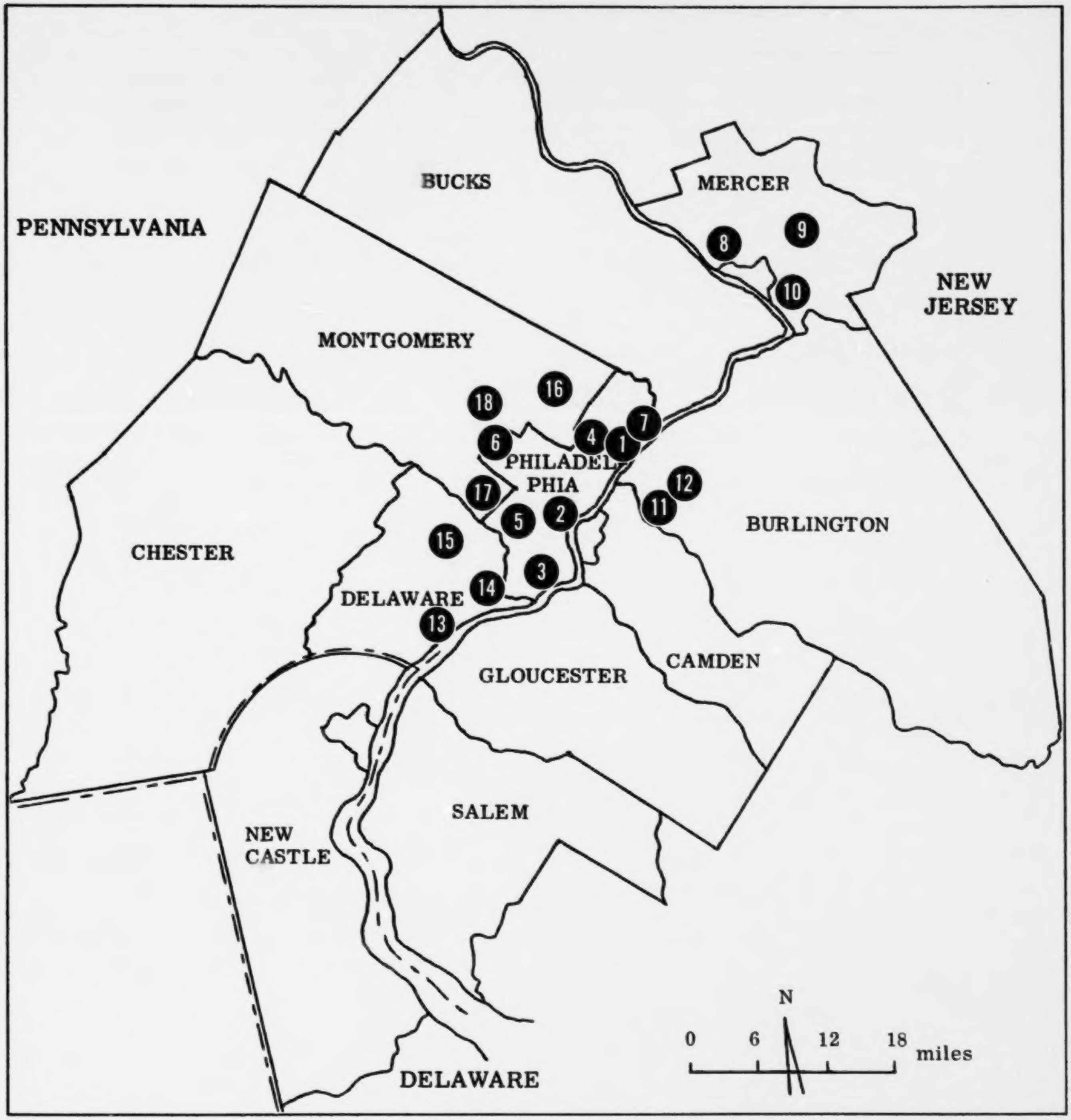


Table F-2

Major Incinerators in the Delaware Valley

No.	Unit	1965 Burning Rate T/D	Location and Operation
1	Northeast	575	Philadelphia Municipal
2	East Central	575	Philadelphia Municipal
3	Southeast	575	Philadelphia Municipal
4	Harrowgate	275	Philadelphia Municipal
5	Bartram	425	Philadelphia Municipal
6	Northwest	575	Philadelphia Municipal
7	Hawthorne	100	Philadelphia; Private Commercial
8	Ewing	250	Mercer Co.; Ewing Twp.
9	Princeton	120	Mercer Co.; Princeton Boro.
10	Hamilton	100	Mercer Co.; Hamilton Twp.
11	Maple Shade	25	Burlington Co.; Township
12	Moorestown	25	Burlington Co.; Township
13	Chester Twp.	270	Delaware County; Township
14	Darby Twp.	200	Delaware County; Township
15	Marple Twp.	240	Delaware County; Township
16	Abington Twp.	150	Montgomery County; Township
17	Lower Merion Twp.	90	Montgomery County; Township
18	Whitemarsh Twp.*	0	Montgomery County; Township

* Not active during 1965

Table F-3

Refuse Disposal Methods in the Delaware Valley, Tons/Day - 1965

County	Municipal Incinerators	Industrial, Commercial Incinerators	Domestic Incinerators	Landfill	Total
Bucks	0	103	69	518	690
Chester	0	74	49	369	492
Delaware	710	177	118	173	1,178
Montgomery	240	176	117	639	1,172
Philadelphia	3,000	1,094	0	0	4,094
Burlington	50	55	55	386	546
Camden	0	86	86	686	858
Gloucester	0	30	30	242	302
Mercer	470	50	50	16	586
Salem	0	1.3	13	102	116
New Castle	0	68	68	540	676
Totals, Tons/Day	4,470	1,914	655	3,671	10,710

It should be noted that the scarcity of data on refuse incineration in the Delaware Valley necessitated judgement as to weight of material burned in different types of incinerators. Likewise, the wide divergence in operating conditions do not permit accurate application of the emission factors used for each type of incinerator. Therefore, the emission tonnages in Table F-5 should be considered as approximate estimates of pollution discharges from this activity.

Table F-4

Emission Factors for Refuse Incineration

Tons pollutant emitted per ton refuse burned

Pollutant	Municipal Incinerator(a) ($x10^{-3}$)	Industrial-Commercial Incinerators(c) ($x10^{-3}$)	Single Chamber Incinerator(d) ($x10^{-3}$)	Combined Incinerator Factors(e) ($x10^{-3}$)
Oxides of Sulfur	0.95	0.6	0.95	0.95
Oxides of Nitrogen	1.05	0.5	0.8	0.8
Organics	1.55	16.3	25.3	20.
Carbon Monoxide	0.35	5.	50.	25.
Benzopyrene(b)	1.32	13.2	22.	22.
Particulates	3.	7.	12.	12.

(a) Emission factor for multiple chambers incinerators. Single chamber emission factor used for Burlington County

(b) Pounds per day

(c) Weighted average of emission factors for multiple chamber and flue-fed incinerators. This factor used only for Philadelphia because of local air pollution control

(d) Single chamber emission factor for Teepee Burner used in Burlington County as Municipal Incinerator

(e) Because of the wide variety of types of incinerators used to burn industrial, commercial and domestic refuse, a weighted average factor was estimated for refuse burned in industrial-commercial and domestic incinerators, except for industrial-commercial incinerators in Philadelphia County (see Note (c)).

Table F-5

Summary of Air Pollution Emissions from Refuse Incineration

Delaware Valley, 1965 -- Tons/Day

Pollutant	Bucks	Chester	Delaware	Mont-gomery	Phila-delphia	Burling-ton	Camden	Glou-cester	Mercer	Salem	New Castle	Total
Oxides of Sulfur	0.2	0.1	1.0	0.5	3.5	0.2	0.2	0.1	0.6	<0.1	0.1	7
Oxides of Nitrogen	0.1	0.1	1.0	0.5	3.7	0.1	0.1	<0.1	0.6	<0.1	0.1	7
Organics	3.5	2.5	7.0	6.2	22.5	3.5	3.4	1.2	2.7	0.5	2.7	58
Carbon Monoxide	4.3	3.1	7.6	7.4	6.5	5.3	4.3	1.5	2.7	0.7	3.4	47
Benzopyrene(*)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1*
Particulates	2.1	1.5	7.1	4.7	16.7	1.9	2.1	0.7	2.6	0.3	1.6	43
Total	10	7	24	19	53	11	10	4	9	2	8	162

(*) Lbs per day

REFERENCES - APPENDIX F

(1) Greater Philadelphia Facts. Greater Philadelphia Chamber of Commerce, Philadelphia, Pa. 19107, 1966.

(2) Mayer, M. A Compilation of Air Pollutant Emission Factors for Combustion Processes. Gasoline Evaporation and Selected Industrial Processes. Public Health Service, Division of Air Pollution, U.S. Department of Health, Education and Welfare, Cincinnati, Ohio, May 1965.

APPENDIX G

AIR POLLUTION EMISSIONS FROM MISCELLANEOUS ACTIVITIES IN THE DELAWARE VALLEY

I INTRODUCTION

The variety of human and machine activities conducted within the Delaware Valley can generate an extensive number of different air pollutants. In Appendices A through F, those pollutants of greatest concern to the region and the source category of these pollutants were presented.

There are several minor sources of air pollutants, both man made and naturally occurring, that are not considered in this report. A partial listing of these would include cigarette smoke, pollen, abrasion of vehicular tires, sea salt, decaying vegetation, construction and demolition activities, use of aerosol sprays, use of perfumes, and fires. Although approximate emissions for these minor sources could have been made, it was felt that additional studies were necessary before a firm emission factor could be calculated.

Specific information has been developed for the release of organic compounds from painting and dry cleaning activities. The emission of these volatile organic solvents from domestic, commercial, governmental and industrial sources in the Delaware Valley is presented in this appendix.

II METHODOLOGY

The release of organic solvents occurs from each of the source categories evaluated in this report. Therefore, the geographical distribution of solvent emissions would require a detailed study. We have calculated solvent losses from this category by using available information showing weight emitted on a population basis.

III CALCULATIONS

A. Solvent Emissions from Surface Coating Operations in the Delaware Valley.

An estimate of the magnitude of solvent emissions from surface coating operations in the Delaware Valley was prepared by the Philadelphia Paint, Varnish, and Lacquer Association and the Philadelphia Society of the Federation for Paint Technology(1). Utilizing the knowledge of the membership of both organizations as well as the National Paint, Varnish, and Lacquer Association, the Committee estimated from sales and marketing information that 90 tons of organic solvents were vaporized daily into the 11-county Delaware Valley during 1965.

A breakdown of solvent emissions by county was made on a population basis. Based upon total population, it was calculated that organic solvent losses from surface coating operations in the Delaware Valley approximate 16.8 tons per day per one million people.

B. Solvent Emissions from Dry Cleaning Operations in the Delaware Valley.

Several metropolitan areas have conducted emission surveys to estimate the emission of organic solvents from dry cleaning plants. Data collected by Los Angeles and San Francisco agree very closely on the basis of pounds of dry cleaning solvents emitted per capita per year. The losses from dry cleaning operations from these two areas averaged 1.7 pounds of chlorinated organic solvents and 2.2 pounds of petroleum solvents totaling 3.9 pounds of organic solvents per capita per year(2).

On a population basis, organic solvent losses from dry cleaning operations for the Delaware Valley amounted to 29 tons per day in 1965; the emission factor was calculated as 5.4 tons per day per one million people.

IV SUMMARY OF AIR POLLUTION EMISSION FROM SURFACE COATING AND DRY CLEANING OPERATIONS IN THE DELAWARE VALLEY FOR 1965.

A summary of organic solvent emissions from surface coating and dry cleaning operations in the Delaware Valley for 1965 is listed in Table G-1. It was assumed that the rate of emission would be constant throughout the year.

Table G-1

Emission of Organic Solvents from Surface Coating and Dry Cleaning Operations in the Delaware Valley for 1965--Tons/Day

County	Surface Coating Operations	Dry Cleaning Operations	Total
Bucks	5.8	1.8	7
Chester	4.1	1.3	5
Delaware	9.9	3.2	13
Montgomery	9.9	3.1	13
Philadelphia	34.5	11.0	45
Burlington	4.6	1.5	6
Camden	7.2	2.3	10
Gloucester	2.5	0.8	3
Mercer	4.9	1.6	7
Salem	1.1	0.3	1
New Castle	5.7	1.8	8
TOTAL	90.2	28.7	118

REFERENCES - APPENDIX G

(1) Personal Communication. Philadelphia Paint, Varnish, and Lacquer Association, Robert M. Fox, Committee Chairman, September 6, 1967.

(2) Ozolins, G. and R. Smith Rapid Survey Technique for Estimating Community Air Pollution Emissions. Publication No. 999-AP-29, National Center for Air Pollution Control, Cincinnati, Ohio, Oct. 1966.

APPENDIX H

RESUME OF AIR POLLUTION EMISSIONS IN THE DELAWARE VALLEY

I INTRODUCTION

The air pollution emissions for each of the source categories discussed in Appendices A through G have been summarized in Tables H-1 through H-11.

From this analysis of data, a geographical distribution of pollution emissions can be derived by comparison of county totals. It is evident that a more detailed analysis of the geographical distribution of emissions would be desirable, i.e., without regard to governmental subdivisions. An investigation of each source category was conducted in order to estimate the nature of such a distribution for the Delaware Valley. In addition, it was considered of interest to further examine the pollutant categories of total organic compounds and total particulate emissions. A determination of the fraction of the organic compounds that are potentially photochemically reactive could yield additional information on the photochemical smog problem in the Region. A similar subdivision of total particulate emissions into the fraction of these dusts having a particle size less than 2 microns in diameter could provide information regarding the potential effects of these pollutants.

A final consideration is given to the immediate effects of the total pollution emissions throughout the Delaware Valley. This would include the nuisance and property damaging effects of a number of substances, including the action of any one of these pollutants itemized or any combination of these substances, or a pollutant group like objectionable odors, which is not specifically itemized in this study. The results of a recent opinion survey of air pollution nuisances throughout the 11 county area were made available for presentation in this report.

II METHODOLOGY AND CALCULATIONS

Within the time limitations of the present study, it was possible to make an approximate estimate of the photochemically reactive fraction of total organic emissions. The calculation was achieved by considering each source category separately and estimating the magnitude of reactive compound emissions such as olefins, aldehydes, organic acids, aromatics, etc. The estimates were based upon a brief analysis of a small number of reports available in the published literature.

The estimation of particle size distribution was achieved in a similar manner; emissions from each source category were examined and a gross estimate was made of the fraction less than 2 microns in size. This estimate was also based upon a brief review of a limited number of references. The total particulate emissions less than 2 microns were then calculated for all sources.

An analysis of the geographical distribution of emissions was conducted by locating specific sources and groups of pollution source categories on regional maps. Previous studies of traffic patterns and land use were most helpful in estimating a geographical distribution. The Penn-Jersey Transportation Study(1) was of particular assistance in making these estimates.

Table H-1

Air Pollution Emissions By Source Category and Month
Bucks County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	2.3	2.3	2.5	2.5	2.6	2.6	2.7	2.7	2.6	2.6	2.5	2.6	2.6
Domestic Fuel	14.6	13.2	10.8	6.7	2.5	1.1	1.1	1.1	1.7	4.6	8.8	13.6	7.
CIG Fuel	10.9	9.9	8.1	5.0	1.9	0.8	0.8	0.8	1.3	3.5	6.6	10.2	5.3
Electric Power	0.7	0.5	0.7	0.8	0.6	0.8	0.8	0.7	0.5	0.6	0.6	0.8	0.7
Industrial	64.	64.	64.	64.	64.	64.	64.	64.	64.	64.	64.	64.	64.
Refuse	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total	92.7	90.1	86.3	79.2	71.8	69.5	69.6	69.5	70.3	75.5	82.7	91.4	79.8
Oxides of Nitrogen													
Transportation	19.2	18.0	21.0	21.4	22.4	23.1	23.5	23.5	22.3	23.4	21.9	22.3	22
Domestic Fuel	18.3	16.7	13.7	8.6	3.5	1.7	1.7	1.7	2.4	6.0	11.3	17.2	9.
CIG Fuel	4.6	4.2	3.4	2.2	0.9	0.4	0.4	0.4	0.6	1.5	2.8	4.3	2.3
Electric Power	0.6	0.5	0.5	0.4	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5
Industrial	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
Refuse	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	60.8	57.5	56.7	50.7	45.3	43.7	44.2	44.2	43.8	49.5	54.6	62.4	51.9
Organic Compounds													
Transportation	87.6	86.6	97.7	99.6	105.6	109.6	111.7	111.7	104.9	105.8	102.9	104.9	104.
Domestic Fuel	7.6	7.0	5.7	3.5	1.3	0.6	0.6	0.6	0.9	2.4	4.6	7.1	4.
CIG Fuel	1.9	1.8	1.4	0.9	0.3	0.2	0.2	0.2	0.2	0.6	1.2	1.8	1.0
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.
Refuse	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Solvents	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
Total	130.6	128.9	138.3	137.5	140.7	143.9	146.0	146.0	139.5	142.3	142.2	147.3	142.5
Carbon Monoxide													
Transportation	393.	383.	439.	449.	476.	496.	505.	505.	472.	476.	463.	472.	470.
Domestic Fuel	8.8	7.9	6.4	3.7	1.0	0.1	0.1	0.1	0.5	2.3	5.1	8.1	4.
CIG Fuel	2.2	2.0	1.6	0.9	0.3	<0.1	<0.1	<0.1	0.1	0.6	1.3	2.0	1.0
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	27.	27.	27.	27.	27.	27.	27.	27.	27.	27.	27.	27.	27.
Refuse	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Total	435.3	424.2	478.3	484.9	508.6	527.4	536.4	536.4	503.9	510.2	500.7	513.4	506.3
Benzopyrene*													
Transportation	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Domestic Fuel	8.7	7.8	6.3	3.6	0.9	0	0	0	0.4	2.2	5.0	8.1	4.
CIG Fuel	2.2	2.0	1.6	0.9	0.2	0	0	0	0.1	0.6	1.3	2.0	1.0
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	11.1	10.0	8.1	4.7	1.3	0.2	0.2	0.2	0.7	3.0	6.5	10.3	5.2*
Particulates													
Transportation	3.5	3.4	3.7	3.7	3.8	3.9	3.9	3.9	3.8	3.8	3.7	3.8	4.
Domestic Fuel	7.0	6.3	5.1	3.1	1.0	0.3	0.3	0.3	0.6	2.0	4.1	6.5	3.
CIG Fuel	1.8	1.6	1.3	0.8	0.3	0.1	0.1	0.1	0.2	0.5	1.0	1.6	0.8
Electric Power	0.7	0.5	0.6	0.5	0.5	0.5	0.6	0.6	0.5	0.6	0.6	0.6	0.6
Industrial	29.	29.	29.	29.	29.	29.	29.	29.	29.	29.	29.	29.	29.
Refuse	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Total	44.1	42.9	41.8	39.2	36.7	35.9	36.0	36.0	36.2	38.0	40.5	43.6	39.5

*lbs/day

Table H-2

Air Pollution Emissions By Source Category and Month
Chester County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	1.1	1.0	1.2	1.2	1.2	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.1
Domestic Fuel	10.3	9.3	7.6	4.6	1.5	0.5	0.5	0.5	0.9	3.0	6.1	9.6	5.
CIG Fuel	7.7	7.0	5.7	3.5	1.1	0.4	0.4	0.4	0.7	2.3	4.6	7.2	3.8
Electric Power	125.	119.	126.	123.	112.	119.	134.	137.	110.	60.	59.	112.	110.
Industrial	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.
Refuse	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	189.2	181.4	185.6	177.4	160.9	166.3	181.3	184.3	157.9	111.6	116.0	175.1	165.0
Oxides of Nitrogen													
Transportation	11.3	11.0	12.4	12.6	13.3	13.7	13.9	13.9	13.2	13.3	12.9	13.2	13.
Domestic Fuel	11.2	10.1	8.3	5.1	1.9	0.8	0.8	0.8	1.3	3.5	6.8	10.5	5
CIG Fuel	2.8	2.5	2.1	1.3	0.5	0.2	0.2	0.2	0.3	0.9	1.7	2.6	1.3
Electric Power	27.	25.	27.	26.	24.	25.	29.	29.	23.	13.	13.	24.	23.
Industrial	14.	14.	14.	14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
Refuse	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	66.4	62.7	63.9	59.1	53.8	53.8	58.0	58.0	51.9	44.8	48.5	64.4	56.4
Organic Compounds													
Transportation	53.7	52.4	59.8	61.1	64.8	67.3	68.4	64.2	64.8	63.0	64.2	64.2	65.
Domestic Fuel	5.6	5.0	4.1	2.5	0.8	0.3	0.3	0.3	0.5	1.6	3.3	5.2	3.
CIG Fuel	1.4	1.3	1.0	0.6	0.2	0.1	0.1	0.1	0.1	0.4	0.8	1.3	1.0
Electric Power	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.2	0.1	0.1	0.2	0.2
Industrial	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
Refuse	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Solvents	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
Total	84.5	82.5	88.7	88.0	89.5	91.5	92.6	88.4	89.1	88.6	91.9	94.4	92.7
Carbon Monoxide													
Transportation	244.	239.	274.	279.	296.	308.	314.	314.	294.	296.	288.	294.	294.
Domestic Fuel	8.7	7.8	6.3	3.6	0.9	0	0	0	0.4	2.2	5.0	8.1	4.
CIG Fuel	2.2	2.0	1.6	0.9	0.2	0	0	0	0.1	0.6	1.3	2.0	1.
Electric Power	0.7	0.6	0.7	0.7	0.6	0.6	0.7	0.7	0.6	0.4	0.3	0.6	0.6
Industrial	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.
Refuse	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Total	277.7	271.5	304.7	306.3	319.8	330.7	336.8	336.8	317.2	321.3	316.7	326.8	321.7
Benzopyrene*													
Transportation	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Domestic Fuel	8.9	8.0	6.4	3.7	0.9	0	0	0	0.4	2.3	5.1	8.2	4.
CIG Fuel	2.2	2.0	1.6	0.9	0.2	0	0	0	0.1	0.6	1.3	2.1	1.
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	11.2	10.1	8.1	4.7	1.2	0.1	0.1	0.1	0.6	3.0	6.5	10.4	5.1*
Particulates													
Transportation	1.8	1.8	1.9	2.0	2.0	2.1	2.1	2.1	2.0	2.0	2.0	2.0	2.
Domestic Fuel	5.9	5.3	4.3	2.5	0.7	0.1	0.1	0.1	0.4	1.6	3.4	5.5	3.
CIG Fuel	1.5	1.3	1.1	0.6	0.2	<0.1	<0.1	<0.1	0.1	0.4	0.9	1.4	0.8
Electric Power	1.0	0.9	1.0	0.9	0.9	0.9	1.0	1.1	0.8	0.5	0.5	0.9	0.8
Industrial	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.
Refuse	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	31.7	30.8	29.8	27.5	25.3	24.6	24.7	24.8	24.8	26.0	28.3	31.3	28.1

*lbs/day

Table H-3

Air Pollution Emissions By Source Category and Month
Delaware County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	3.1	3.1	3.4	3.4	3.5	3.6	3.7	3.7	3.5	3.5	3.5	3.5	3.4
Domestic Fuel	18.5	16.7	13.6	8.3	2.9	1.1	1.1	1.1	1.9	5.6	11.1	17.1	8.
CIG Fuel	13.9	12.5	10.2	6.2	2.2	0.8	0.8	0.8	1.4	4.2	8.3	12.8	6.
Electric Power	229.	206.	186.	134.	233.	230.	241.	259.	245.	216.	240.	225.	220.
Industrial	208.	208.	208.	208.	208.	208.	208.	208.	208.	208.	208.	208.	208.
Refuse	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	473.5	447.3	422.2	360.9	450.6	444.5	455.6	473.6	460.8	438.3	471.9	467.4	446.4
Oxides of Nitrogen													
Transportation	28.6	28.1	31.5	32.0	33.8	34.9	35.5	35.5	35.5	33.8	32.9	33.5	33.
Domestic Fuel	26.4	24.0	19.7	12.3	4.7	2.2	2.2	2.2	3.3	8.4	15.6	24.7	12.
CIG Fuel	6.6	6.0	4.9	3.1	1.2	0.6	0.6	0.6	0.8	2.1	3.9	6.2	3.
Electric Power	55.	49.	45.	32.	55.	55.	58.	62.	59.	52.	58.	54.	52.
Industrial	43.	43.	43.	43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
Refuse	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	160.6	151.1	145.1	123.4	138.7	136.7	140.3	144.3	142.6	140.3	154.4	162.4	144.0
Organic Compounds													
Transportation	136.	133.	152.	155.	164.	171.	174.	174.	163.	164.	160.	163.	163.
Domestic Fuel	12.7	11.6	9.5	5.9	2.3	1.1	1.1	1.1	1.6	4.1	7.8	11.9	6.
CIG Fuel	3.2	2.9	2.4	1.5	0.6	0.3	0.3	0.3	0.4	1.0	2.0	3.0	1.5
Electric Power	0.6	0.5	0.5	0.4	0.6	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6
Industrial	161.	161.	161.	161.	161.	161.	161.	161.	161.	161.	161.	161.	161.
Refuse	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Solvents	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
Total	333.5	329.0	345.4	343.8	438.5	354.0	357.0	357.1	346.6	350.7	351.4	359.5	352.1
Carbon Monoxide													
Transportation	620.	605.	694.	708.	753.	781.	788.	788.	744.	753.	730.	744.	735.
Domestic Fuel	10.2	9.2	7.4	4.3	1.2	0.1	0.1	0.1	0.6	2.7	5.9	9.5	4.
CIG Fuel	2.6	2.3	1.9	1.1	0.3	<0.1	<0.1	<0.1	0.2	0.7	1.5	2.4	1.
Electric Power	1.3	1.2	1.1	0.8	1.4	1.4	1.4	1.5	1.4	1.3	1.4	1.3	1.3
Industrial	720.	720.	720.	720.	720.	720.	720.	720.	720.	720.	720.	720.	720.
Refuse	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Total	1361.7	1345.3	1432.0	1441.8	1483.5	1510.1	1517.1	1517.2	1473.8	1485.3	1466.4	1484.8	1468.9
Benzopyrene*													
Transportation	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Domestic Fuel	10.0	9.1	7.3	4.2	1.1	0	0	0	0.5	2.6	5.8	9.4	4.
CIG Fuel	2.5	2.3	1.8	1.1	0.3	0	0	0	0.1	0.7	1.5	2.4	1.
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	12.8	11.7	9.4	5.6	1.8	0.4	0.4	0.4	1.0	3.7	7.7	12.2	5.4*
Particulates													
Transportation	4.6	4.6	4.9	5.0	5.1	5.2	5.3	5.3	5.1	5.1	5.1	5.1	5.
Domestic Fuel	9.0	8.1	6.6	4.0	1.3	0.4	0.4	0.4	0.8	2.6	5.3	8.4	4.
CIG Fuel	2.3	2.0	1.7	1.0	0.3	0.1	0.1	0.1	0.2	0.7	1.3	2.1	1.
Electric Power	10.4	8.9	9.6	7.5	10.7	11.5	12.3	13.3	12.4	11.0	12.0	10.9	10.7
Industrial	48.	48.	48.	48.	48.	48.	48.	48.	48.	48.	48.	48.	48.
Refuse	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Total	81.4	78.7	77.9	72.6	72.5	72.3	73.2	74.2	73.6	74.5	78.8	81.6	75.8

*lbs/day

Table H-4

Air Pollution Emissions By Source Category and Month
Montgomery County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	2.8	2.8	3.1	3.1	3.2	3.3	3.4	3.4	3.2	3.2	3.2	3.2	3.
Domestic Fuel	21.5	19.5	15.9	9.7	3.4	1.3	1.3	1.3	2.2	6.5	12.9	20.1	10.
CIG Fuel	16.1	14.6	11.9	7.3	2.6	1.0	1.0	1.0	1.7	4.9	9.7	15.1	7.5
Electric Power	34.	21.	24.	19.	24.	32.	36.	39.	36.	37.	35.	35.	31.
Industrial	115.	115.	115.	115.	115.	115.	115.	115.	115.	115.	115.	115.	115.
Refuse	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total	189.9	173.4	170.4	154.6	148.7	153.1	157.2	160.2	158.6	176.1	176.3	188.9	167.0
Oxides of Nitrogen													
Transportation	29.8	29.2	32.7	33.3	35.4	36.1	36.7	36.7	34.7	35.4	34.1	34.7	34.
Domestic Fuel	26.2	23.8	19.6	12.2	4.8	2.3	2.3	2.3	3.4	8.4	16.0	24.5	12
CIG Fuel	6.6	6.0	4.9	3.1	1.2	0.6	0.6	0.6	0.9	2.1	4.0	6.1	3
Electric Power	8.0	4.9	5.7	4.4	5.7	7.5	8.5	9.0	8.5	8.6	8.2	8.2	7.0
Industrial	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
Refuse	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total	106.1	99.4	98.4	88.5	82.6	82.0	83.6	84.1	83.0	90.0	97.8	109.0	91.5
Organic Compounds													
Transportation	139.	135.	154.	158.	167.	174.	177.	177.	166.	167.	163.	166.	164.
Domestic Fuel	13.5	12.2	7.9	6.2	2.3	1.0	1.0	1.0	1.6	4.2	8.2	12.6	6.
CIG Fuel	3.4	3.1	2.0	1.6	0.6	0.3	0.3	0.3	0.4	1.1	2.1	3.2	1.5
Electric Power	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2
Industrial	52.	52.	52.	52.	52.	52.	52.	52.	52.	52.	52.	52.	52.
Refuse	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Solvents	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
Total	227.4	221.7	235.3	237.2	241.3	246.7	249.7	249.8	239.5	243.8	244.8	253.2	242.9
Carbon Monoxide													
Transportation	628.	614.	702.	717.	762.	792.	807.	807.	756.	762.	741.	756.	745.
Domestic Fuel	17.2	15.5	12.5	7.2	1.9	0.1	0.1	0.1	0.9	4.5	9.9	16.0	7.
CIG Fuel	4.3	3.9	3.1	1.8	0.5	<0.1	<0.1	<0.1	0.2	1.1	2.5	4.0	1.8
Electric Power	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Industrial	120.	120.	120.	120.	120.	120.	120.	120.	120.	120.	120.	120.	120.
Refuse	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	777.1	760.9	845.1	853.5	891.9	919.7	934.7	934.7	884.7	895.2	881.0	903.6	881.4
Benzopyrene*													
Transportation	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Domestic Fuel	17.3	15.6	12.5	7.2	1.8	0	0	0	0.8	4.5	10.0	16.1	7.
CIG Fuel	4.3	3.9	3.1	1.8	0.5	0	0	0	0.2	1.1	2.5	4.0	1.8
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	21.9	19.8	15.9	9.3	2.7	0.4	0.4	0.4	1.4	6.0	12.9	20.5	9.2*
Particulates													
Transportation	5.4	5.3	5.7	5.7	5.9	6.0	6.1	6.1	5.9	5.9	5.8	5.9	6.
Domestic Fuel	12.0	11.0	18.9	5.3	1.6	0.4	0.4	0.4	0.9	3.4	7.2	11.4	5.
CIG Fuel	3.1	2.8	2.2	1.3	0.4	0.1	0.1	0.1	0.2	0.9	1.8	2.9	1.3
Electric Power	4.1	2.8	3.0	2.6	3.1	3.8	4.3	4.5	4.3	3.4	4.2	4.2	3.8
Industrial	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.
Refuse	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Total	79.5	76.6	84.5	69.6	65.7	65.0	65.6	65.8	66.0	68.3	73.7	79.1	70.8

*lbs/day

Table H-5

Air Pollution Emissions By Source Category and Month
Philadelphia County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	6.7	6.6	7.3	7.4	7.8	8.0	8.1	8.1	7.7	7.8	7.6	7.7	7.4
Domestic Fuel	80.5	72.8	59.1	35.4	11.4	3.4	3.4	3.4	6.8	23.2	47.7	75.1	35.
CIG Fuel	60.4	54.6	44.3	26.6	8.6	2.6	2.6	2.6	5.1	17.4	35.8	56.3	25.3
Electric Power	297.	247.	285.	269.	250.	300.	326.	238.	318.	343.	317.	311.	299.
Industrial	412.	412.	412.	412.	412.	412.	412.	412.	412.	412.	412.	412.	412.
Refuse	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Total	860.1	796.5	811.2	753.9	693.3	729.5	755.6	757.6	753.1	806.9	823.6	865.6	782.2
Oxides of Nitrogen													
Transportation	70.9	68.9	81.9	83.9	87.9	90.9	91.9	91.9	86.9	87.9	85.9	86.9	86.
Domestic Fuel	87.0	79.2	65.1	40.8	16.0	7.8	7.8	7.8	11.3	28.2	53.3	81.6	40.
CIG Fuel	21.8	19.8	16.3	10.2	4.0	2.0	2.0	2.0	2.8	7.1	13.3	20.4	10.
Electric Power	84.	67.	80.	74.	66.	83.	89.	91.	87.	94.	89.	88.	82.
Industrial	102.	102.	102.	102.	102.	102.	102.	102.	102.	102.	102.	102.	102.
Refuse	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Total	369.4	340.6	349.0	314.6	279.6	289.4	296.4	298.4	293.7	322.9	347.2	382.6	323.7
Organic Compounds													
Transportation	355.	347.	396.	404.	428.	445.	454.	454.	425.	428.	417.	425.	415.
Domestic Fuel	58.7	53.3	43.7	27.1	10.2	4.6	4.6	4.6	7.0	18.5	35.7	54.9	27.
CIG Fuel	14.7	13.3	10.9	6.8	2.6	1.2	1.2	1.2	1.8	4.6	8.9	13.7	7.0
Electric Power	1.7	1.4	1.5	1.4	1.1	1.6	1.6	1.7	1.6	1.7	1.8	1.8	1.6
Industrial	251.	251.	251.	251.	251.	251.	251.	251.	251.	251.	251.	251.	251.
Refuse	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Solvents	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.
Total	748.6	733.5	770.6	757.8	760.4	770.9	779.9	780.0	753.9	771.3	781.9	813.9	769.1
Carbon Monoxide													
Transportation	1639.	1599.	1829.	1859.	1979.	2054.	2094.	2094.	1959.	1979.	1929.	1959.	1928.
Domestic Fuel	91.7	82.7	66.3	38.3	9.7	0.2	0.2	0.2	4.3	23.8	52.7	85.4	38.
CIG Fuel	22.9	20.7	16.6	9.6	2.4	0.1	0.1	0.1	1.1	6.0	13.2	21.4	10.
Electric Power	1.2	1.1	1.3	1.1	1.2	1.4	1.5	1.6	1.5	1.6	1.4	1.3	1.4
Industrial	933.	933.	933.	933.	933.	933.	933.	933.	933.	933.	933.	933.	933.
Refuse	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Total	2694.3	2643.0	2852.7	2847.5	2931.8	2995.2	3035.3	3035.4	2905.4	2949.9	2935.8	3006.6	2916.9
Benzopyrene*													
Transportation	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9
Domestic Fuel	93.9	84.6	67.8	39.0	9.8	0	0	0	4.2	24.2	53.9	87.3	39.
CIG Fuel	23.5	21.2	17.0	9.8	2.5	0	0	0	1.1	6.1	13.5	21.8	10.
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	118.2	106.6	85.7	49.7	13.2	1.0	1.0	1.0	6.2	31.2	68.3	110.0	49.9*
Particulates													
Transportation	14.3	14.2	15.1	15.2	15.6	15.9	16.0	16.0	15.3	15.6	15.4	15.5	16.
Domestic Fuel	57.0	51.5	41.6	24.5	7.1	1.3	1.3	1.3	3.8	15.7	33.3	53.2	24.
CIG Fuel	14.3	12.9	10.4	6.1	1.8	0.3	0.3	0.3	1.0	3.9	8.3	13.3	6.
Electric Power	30.	26.	29.	28.	26.	31.	33.	33.	32.	33.	31.	33.	30.
Industrial	140.	140.	140.	140.	140.	140.	140.	140.	140.	140.	140.	140.	140.
Refuse	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7
Total	272.3	261.3	252.8	230.5	207.2	205.2	207.3	207.3	209.0	224.9	244.7	271.7	232.7

*lbs/day

Table H-6

Air Pollution Emissions By Source Category and Month
Burlington County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	1.5	1.5	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.7	1.6
Domestic Fuel	8.4	7.6	6.1	3.7	1.1	0.3	0.3	0.3	0.7	2.4	4.9	7.8	4.
CIG Fuel	6.3	5.7	4.6	2.8	0.8	0.2	0.2	0.2	0.5	1.8	3.7	5.9	3.
Electric Power	82.	69.	78.	67.	68.	72.	81.	89.	69.	84.	61.	52.	72.
Industrial	29.	29.	29.	29.	29.	29.	29.	29.	29.	29.	29.	29.	29.
Refuse	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total	127.4	113.0	119.5	104.3	100.8	103.4	112.4	120.4	101.1	119.1	100.4	96.6	109.8
Oxides of Nitrogen													
Transportation	12.2	11.9	13.4	13.6	14.3	14.6	15.0	15.0	14.2	14.3	13.9	14.2	14.
Domestic Fuel	10.6	9.6	7.8	4.7	1.6	0.6	0.6	0.6	1.0	3.2	6.3	9.9	5.
CIG Fuel	2.7	2.4	2.0	1.2	0.4	0.2	0.2	0.2	0.3	0.8	1.6	2.5	1.2
Electric Power	24.	20.	22.	18.	20.	23.	23.	24.	20.	24.	23.	17.	21.
Industrial	9.	9.	9.	9.	9.	9.	9.	9.	9.	9.	9.	9.	9.
Refuse	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	58.6	53.0	54.3	46.6	45.4	47.5	47.9	48.9	44.6	51.4	53.9	52.7	50.3
Organic Compounds													
Transportation	57.0	55.7	63.6	64.9	68.7	71.4	72.7	72.7	68.2	68.7	66.0	68.2	66.
Domestic Fuel	5.4	4.9	4.0	2.5	0.9	0.4	0.4	0.4	0.6	1.7	3.3	5.0	3.
CIG Fuel	1.4	1.2	1.0	0.6	0.2	0.1	0.1	0.1	0.2	0.4	0.8	1.3	0.8
Electric Power	0.6	0.5	0.5	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5
Industrial	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
Refuse	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Solvents	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
Total	86.9	84.8	91.6	90.9	92.9	95.0	96.3	96.3	92.1	93.9	94.0	97.5	92.8
Carbon Monoxide													
Transportation	260.	254.	291.	297.	315.	318.	334.	334.	312.	315.	306.	312.	306.
Domestic Fuel	6.1	5.5	4.4	2.5	0.6	0	0	0	0.3	1.6	3.5	5.7	3.
CIG Fuel	1.5	1.4	1.1	0.6	0.2	0	0	0	0.1	0.4	0.9	1.4	0.8
Electric Power	0.3	0.2	0.3	0.2	0.2	0.2	0.3	0.3	0.2	0.3	0.3	0.1	0.2
Industrial	28.	28.	28.	28.	28.	28.	28.	28.	28.	28.	28.	28.	28.
Refuse	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Total	301.2	294.4	330.1	333.6	249.3	351.5	367.6	367.6	345.9	350.6	344.0	352.5	343.3
Benzopyrene*													
Transportation	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Domestic Fuel	6.4	5.7	4.6	2.6	0.7	0	0	0	0.3	1.6	3.7	5.9	3.
CIG Fuel	1.6	1.4	1.2	0.7	0.2	0	0	0	0.1	0.4	0.9	1.5	0.8
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	8.1	7.2	5.9	3.4	1.1	0.2	0.2	0.2	0.6	2.2	4.8	7.6	4.0*
Particulates													
Transportation	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.6	2.6	2.6	2.6	3.
Domestic Fuel	4.6	4.1	3.3	2.0	0.6	0.1	0.1	0.1	0.3	1.2	2.7	4.2	2.
CIG Fuel	1.2	1.0	0.8	0.5	0.2	<0.1	<0.1	<0.1	0.1	0.3	0.7	1.1	0.5
Electric Power	2.6	2.2	2.7	2.6	1.8	2.2	2.9	3.5	2.0	2.8	1.8	0.9	2.3
Industrial	11.	11.	11.	11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
Refuse	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Total	23.7	22.6	22.2	20.5	18.1	17.8	18.6	19.2	17.9	19.8	20.7	21.7	20.7

*lbs/day

Table H-7

Air Pollution Emissions By Source Category and Month
Camden County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	2.1	2.1	2.2	2.3	2.4	2.4	2.5	2.5	2.4	2.4	2.4	2.4	2.4
Domestic Fuel	16.7	15.2	12.3	7.3	2.3	0.6	0.6	0.6	1.3	4.3	9.1	15.6	7.
CIG Fuel	12.5	11.4	9.2	5.5	1.7	0.5	0.5	0.5	1.0	3.6	7.4	11.7	5.3
Electric Power	-	-	-	-	-	-	-	-	-	-	-	-	-
Industrial	66.	66.	66.	66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
Refuse	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total	97.5	94.9	89.9	81.3	72.6	69.7	69.8	69.8	70.9	76.5	85.9	95.9	80.9
Oxides of Nitrogen													
Transportation	18.1	17.8	20.0	20.4	21.6	22.4	22.8	22.8	21.4	21.4	21.0	21.4	21.
Domestic Fuel	20.4	18.5	15.1	9.3	3.4	1.4	1.4	1.4	2.2	6.3	12.3	19.0	9.
CIG Fuel	5.1	4.6	3.8	2.3	0.9	0.4	0.4	0.4	0.6	1.6	3.1	4.8	2.3
Electric Power	-	-	-	-	-	-	-	-	-	-	-	-	-
Industrial	17.	17.	17.	17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
Refuse	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	60.7	58.0	56.0	49.1	43.0	41.3	41.7	41.7	41.3	46.4	53.5	62.3	49.4
Organic Compounds													
Transportation	90.8	88.8	100.8	103.8	109.8	113.8	115.8	115.8	108.8	109.8	106.8	108.8	107.
Domestic Fuel	10.7	9.7	8.0	4.9	1.8	0.8	0.8	0.8	1.3	3.4	6.5	10.0	5.
CIG Fuel	2.7	2.4	2.0	1.2	0.5	0.2	0.2	0.2	0.3	0.9	1.6	2.5	1.3
Electrical Power	-	-	-	-	-	-	-	-	-	-	-	-	-
Industrial	39.	39.	39.	39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
Refuse	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Solvent	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
Total	156.6	153.3	163.2	162.3	164.5	167.2	169.2	169.2	162.8	166.5	167.3	173.7	165.7
Carbon Monoxide													
Transportation	415.	405.	465.	475.	504.	524.	534.	534.	500.	504.	490.	500.	495.
Domestic Fuel	13.8	12.4	10.0	5.7	1.4	0	0	0	0.6	3.5	7.9	12.8	6.
CIG Fuel	3.5	3.1	2.5	1.4	0.4	0	0	0	0.2	0.9	2.0	3.2	1.3
Electrical Power	-	-	-	-	-	-	-	-	-	-	-	-	-
Industrial	142.	142.	142.	142.	142.	142.	142.	142.	142.	142.	142.	142.	142.
Refuse	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Total	578.6	566.8	623.8	628.4	652.1	670.3	680.3	680.3	647.1	654.7	646.2	662.3	648.6
Benzopyrene*													
Transportation	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2
Domestic Fuel	14.0	12.6	10.1	5.8	1.5	0	0	0	0.6	3.6	8.0	13.0	6.
CIG Fuel	3.5	3.2	2.5	1.5	0.4	0	0	0	0.2	0.9	2.0	3.3	1.3
Electric Power	-	-	-	-	-	-	-	-	-	-	-	-	-
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	17.7	16.0	12.8	7.5	2.1	0.2	0.3	0.3	1.0	4.7	10.2	16.5	7.5*
Particulates													
Transportation	2.5	2.4	2.7	2.7	2.8	2.9	2.9	2.8	2.8	2.8	2.8	2.8	3.
Domestic Fuel	9.7	8.7	7.1	4.1	1.2	0.2	0.2	0.2	0.6	2.6	5.6	9.0	4.
CIG Fuel	2.4	2.2	1.8	1.0	0.3	0.1	0.1	0.1	0.2	0.7	1.4	2.3	1.0
Electric Power	-	-	-	-	-	-	-	-	-	-	-	-	-
Industrial	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.
Refuse	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Total	40.7	39.4	37.7	33.9	30.4	29.3	29.3	29.2	29.7	32.2	35.9	40.2	34.1

*lbs/day

Table H-8

Air Pollution Emissions By Source Category and Month
Gloucester County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Domestic Fuel	5.7	5.1	4.1	2.5	0.8	0.2	0.2	0.2	0.4	1.6	3.3	5.3	2.
CIG Fuel	4.3	3.8	3.1	1.9	0.6	0.2	0.2	0.2	0.3	1.2	2.5	4.0	1.5
Electric Power	26.	23.	26.	24.	25.	20.	25.	26.	26.	21.	25.	26.	24.
Industrial	79.	79.	79.	79.	79.	79.	79.	79.	79.	79.	79.	79.	79.
Refuse	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	116.2	112.1	113.5	108.7	106.7	100.7	105.7	106.7	107.0	104.1	111.1	115.6	107.8
Oxides of Nitrogen													
Transportation	7.5	7.3	8.2	8.4	8.8	9.1	9.3	9.3	8.7	8.8	8.6	8.7	9.
Domestic Fuel	7.5	6.8	5.6	3.4	1.2	0.5	0.5	0.5	0.8	2.3	4.5	7.0	3.
CIG Fuel	1.9	1.7	1.4	0.9	0.3	0.1	0.1	0.1	0.2	0.6	1.1	1.8	0.8
Electric Power	6.0	5.4	6.0	5.5	5.8	4.7	5.8	5.9	5.9	4.9	5.8	5.9	5.6
Industrial	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
Refuse	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	38.9	37.2	37.2	34.2	32.1	30.4	31.7	31.8	31.6	32.6	36.0	39.4	34.4
Organic Compounds													
Transportation	35.5	34.7	39.5	40.4	42.8	44.6	45.4	45.4	42.5	42.5	41.6	42.5	42.
Domestic Fuel	3.3	3.0	2.4	1.5	0.5	0.2	0.2	0.2	0.3	1.0	2.0	3.1	2.
CIG Fuel	0.8	0.8	0.6	0.4	0.1	0.1	0.1	0.1	0.1	0.3	0.5	0.8	0.5
Electric Power	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Industrial	61.	61.	61.	61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
Refuse	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Solvents	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
Total	104.9	103.8	107.8	107.6	108.7	110.2	111.0	111.0	108.2	109.1	109.4	111.7	109.8
Carbon Monoxide													
Transportation	162.	158.	181.	184.	196.	204.	208.	208.	194.	196.	190.	194.	195.
Domestic Fuel	3.5	3.1	2.5	1.4	0.4	0	0	0	0.2	0.9	2.0	3.2	1.
CIG Fuel	0.9	0.8	0.6	0.4	0.1	0	0	0	0.1	0.2	0.5	0.8	0.3
Electric Power	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Industrial	276.	276.	276.	276.	276.	276.	276.	276.	276.	276.	276.	276.	276.
Refuse	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	444.0	439.5	461.8	463.4	474.1	481.6	485.6	485.6	471.9	474.7	470.1	475.6	473.9
Benzopyrene*													
Transportation	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Domestic Fuel	3.5	3.1	2.5	1.4	0.4	0	0	0	0.2	0.9	2.0	3.2	1.
CIG Fuel	0.9	0.8	0.6	0.4	0.1	0	0	0	0.1	0.2	0.5	0.8	0.3
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	4.5	4.0	3.2	1.9	0.6	0.1	0.1	0.1	0.4	1.2	2.6	4.1	1.4*
Particulates													
Transportation	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.
Domestic Fuel	2.8	2.5	2.0	1.2	0.4	0.1	0.1	0.1	0.2	0.8	1.6	2.6	1.
CIG Fuel	0.7	0.6	0.5	0.3	0.1	<0.1	<0.1	<0.1	0.1	0.2	0.4	0.7	0.3
Electric Power	9.9	8.9	10.1	8.9	9.7	7.6	9.4	9.6	9.4	8.1	9.5	9.6	9.2
Industrial	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
Refuse	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Total	33.4	32.0	32.7	30.5	30.3	27.9	29.7	29.9	29.9	29.2	31.6	33.0	30.2

*lbs/day

Table H-9

Air Pollution Emissions By Source Category and Month
Mercer County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	1.6	1.5	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.7
Domestic Fuel	11.9	10.8	7.2	5.4	2.0	0.8	0.8	0.8	1.3	3.7	7.3	11.4	5.
CIG Fuel	8.9	8.1	5.4	4.1	1.5	0.6	0.6	0.6	1.0	2.8	5.5	8.6	3.8
Electric Power	205.	179.	212.	216.	136.	192.	221.	253.	163.	149.	203.	254.	198.
Industrial	36.	36.	36.	36.	36.	36.	36.	36.	36.	36.	36.	36.	36.
Refuse	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total	264.0	236.0	262.9	263.8	177.9	231.8	260.8	292.8	203.7	193.9	254.2	312.4	245.1
Oxides of Nitrogen													
Transportation	14.5	14.2	15.9	16.2	17.1	17.6	17.9	17.9	16.9	17.1	16.7	16.9	17.
Domestic Fuel	15.3	14.0	11.5	7.0	2.9	1.4	1.4	1.4	2.0	5.0	9.4	14.4	7.
CIG Fuel	3.8	3.5	2.9	1.8	0.7	0.4	0.4	0.4	0.5	1.3	2.4	3.6	1.8
Electric Power	39.	34.	40.	44.	28.	35.	42.	48.	34.	32.	39.	48.	38.
Industrial	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
Refuse	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total	85.2	78.3	82.9	81.6	61.3	67.0	74.3	80.3	66.0	68.0	80.1	95.5	76.4
Organic Compounds													
Transportation	68.5	67.0	67.4	68.0	82.5	85.9	87.5	87.5	81.9	82.5	70.3	81.1	81.
Domestic Fuel	7.3	6.7	5.5	3.5	1.4	0.7	0.7	0.7	1.0	2.4	4.5	6.9	3.
CIG Fuel	1.8	1.7	1.4	0.9	0.4	0.2	0.2	0.2	0.3	0.6	1.1	1.7	0.8
Electric Power	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.5	0.3	0.3	0.4	0.5	0.4
Industrial	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
Refuse	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Solvents	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
Total	103.7	101.5	100.4	98.5	110.3	112.9	114.5	114.6	109.2	111.5	102.0	115.9	110.9
Carbon Monoxide													
Transportation	313.8	313.8	390.8	357.8	380.8	394.8	401.8	401.8	376.8	380.8	369.8	376.8	380.
Domestic Fuel	8.4	7.5	6.1	3.5	0.9	0	0	0	0.4	2.2	4.8	7.8	4.
CIG Fuel	2.1	1.9	1.5	0.9	0.2	0	0	0	0.1	0.6	1.2	2.0	1.0
Electric Power	1.0	0.9	1.0	1.0	0.7	0.9	1.0	1.2	0.8	0.7	1.0	1.2	0.9
Industrial	33.	33.	33.	33.	33.	33.	33.	33.	33.	33.	33.	33.	33.
Refuse	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Total	361.0	359.8	435.8	398.9	418.3	431.4	438.5	438.7	413.8	420.0	412.5	423.5	421.6
Benzopyrene*													
Transportation	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Domestic Fuel	8.5	7.7	6.2	3.6	1.0	0.1	0.1	0.1	0.5	2.3	4.9	7.9	4.
CIG Fuel	2.1	1.9	1.6	0.9	0.3	<0.1	<0.1	<0.1	0.1	0.6	1.2	2.0	1.
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	10.8	9.8	8.0	4.7	1.5	0.3	0.3	0.3	0.8	3.1	6.3	10.1	5.2*
Particulates													
Transportation	4.0	2.9	3.1	3.1	3.2	3.3	3.3	3.3	3.2	3.2	3.2	3.2	3.
Domestic Fuel	6.3	5.7	4.6	2.7	0.8	0.2	0.2	0.2	0.5	1.8	3.7	5.8	3.
CIG Fuel	1.6	1.4	1.2	0.7	0.2	0.1	0.1	0.1	0.1	0.5	0.9	1.5	0.8
Electric Power	6.0	5.2	6.2	6.3	4.0	5.6	6.4	7.4	4.7	4.3	5.9	7.4	5.7
Industrial	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.
Refuse	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Total	39.5	36.8	36.7	34.4	29.8	30.8	31.6	32.6	30.1	31.4	35.3	39.5	34.1

*lbs/day

Table H-10

Air Pollution Emissions By Source Category and Month
Salem County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Domestic Fuel	3.2	2.9	2.3	1.4	0.4	0.1	0.1	0.1	0.2	0.9	1.8	3.0	1.
CIG Fuel	2.4	2.2	1.7	1.1	0.3	0.1	0.1	0.1	0.2	0.7	1.4	2.3	0.8
Electric Power	103.	77.	98.	71.	79.	94.	90.	112.	83.	97.	97.	96.	91.
Industrial	31.	31.	31.	31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	140.4	113.9	133.8	105.3	111.6	126.1	122.1	144.1	115.3	130.5	132.1	133.2	124.7
Oxides of Nitrogen													
Transportation	3.3	3.3	3.6	3.7	3.9	4.0	4.1	4.1	3.8	5.9	3.8	3.8	4.
Domestic Fuel	4.0	3.6	3.0	1.9	0.6	0.2	0.2	0.2	0.4	1.2	2.4	3.7	2.
CIG Fuel	1.0	0.9	0.8	0.5	0.2	0.1	0.1	0.1	0.1	0.3	0.6	0.9	0.5
Electric Power	25.	18.	24.	19.	19.	22.	12.	27.	20.	23.	23.	23.	21.
Industrial	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	43.3	35.8	41.4	35.1	33.7	36.3	26.4	41.4	34.3	40.4	39.8	41.4	37.5
Organic Compounds													
Transportation	15.0	14.6	16.7	17.0	18.0	18.7	19.1	19.1	17.8	18.0	17.5	17.8	18.
Domestic Fuel	1.6	1.5	1.2	0.7	0.3	0.1	0.1	0.1	0.2	0.5	1.0	1.5	1.
CIG Fuel	0.4	0.4	0.3	0.2	0.1	<0.1	<0.1	<0.1	0.1	0.1	0.3	0.4	0.1
Electric Power	0.5	0.3	0.5	0.4	0.4	0.4	0.4	0.6	0.4	0.5	0.5	0.4	0.4
Industrial	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
Refuse	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Solvents	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
Total	29.0	28.3	30.2	29.8	30.3	30.7	31.1	31.3	30.0	30.6	30.8	31.6	31.0
Carbon Monoxide													
Transportation	67.6	66.0	75.6	77.2	82.0	85.2	86.8	86.8	81.2	82.0	79.7	81.2	82.
Domestic Fuel	1.9	1.7	1.3	0.8	0.2	0	0	0	0.1	0.5	1.1	1.7	1.
CIG Fuel	0.5	0.4	0.3	0.2	0.1	0	0	0	<0.1	0.1	0.3	0.4	0.3
Electric Power	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Industrial	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
Refuse	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Total	73.1	71.1	80.2	81.2	85.3	88.3	89.9	89.9	84.3	85.6	84.1	86.3	86.3
Benzopyrene*													
Transportation	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Domestic Fuel	1.9	1.7	1.3	0.8	0.2	0	0	0	0.1	0.5	1.1	1.7	1.
CIG Fuel	0.5	0.4	0.3	0.2	0.1	0	0	0	<0.1	0.1	0.3	0.4	0.3
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	2.4	2.1	1.6	1.0	0.3	0	0	0	0.1	0.6	1.4	2.1	1.3*
Particulates													
Transportation	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Domestic Fuel	1.5	1.3	1.1	0.6	0.2	0	0	0	0.1	0.4	0.8	1.4	1.
CIG Fuel	0.4	0.3	0.3	0.2	0.1	0	0	0	<0.1	0.1	0.2	0.4	0.3
Electric Power	21.	17.	19.	16.	17.	21.	21.	21.	15.	20.	19.	20.	19.
Industrial	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.
Refuse	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total	42.9	38.6	40.4	36.8	37.3	41.0	41.0	41.0	35.1	40.5	40.0	41.8	40.3

*lbs/day

Table H-11

Air Pollution Emissions By Source Category and Month
New Castle County, 1965 -- Tons per Day

Pollutant	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave. Day
Oxides of Sulfur													
Transportation	1.8	1.8	1.9	2.0	2.1	2.1	2.1	2.1	2.0	2.1	2.0	2.0	1.9
Domestic Fuel	13.1	11.9	9.7	5.9	2.0	0.7	0.7	0.7	1.3	3.9	7.8	12.3	6.
CIG Fuel	9.8	8.9	7.3	4.4	1.5	0.5	0.5	0.5	1.0	2.9	5.9	9.2	4.5
Electric Power	231.	215.	226.	187.	170.	173.	247.	224.	175.	186.	220.	230.	205.
Industrial	70.	70.	70.	70.	70.	70.	70.	70.	70.	70.	70.	70.	70.
Refuse	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Total	326.4	308.3	315.6	270.0	246.3	247.0	321.0	298.0	250.0	265.6	306.4	324.2	288.1
Oxides of Nitrogen													
Transportation	16.2	15.9	17.9	18.2	19.2	19.9	20.2	20.2	19.0	19.2	18.7	19.0	19.
Domestic Fuel	17.4	15.8	12.9	8.0	3.0	1.3	1.3	1.3	2.0	5.4	10.5	16.2	8.
CIG Fuel	4.4	4.0	3.2	2.0	0.8	0.3	0.3	0.3	0.5	1.4	2.6	4.1	2.
Electric Power	31.	28.	29.	25.	24.	27.	31.	31.	27.	27.	29.	32.	28.
Industrial	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
Refuse	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	87.1	81.8	81.1	71.3	65.1	66.6	70.9	70.9	66.6	71.1	78.9	89.4	75.1
Organic Compounds													
Transportation	78.6	76.8	87.7	89.4	94.9	97.5	100.4	100.4	94.0	94.9	92.3	94.0	93.
Domestic Fuel	7.6	6.9	5.7	3.5	1.3	0.6	0.6	0.6	0.9	2.4	4.6	7.1	4.
CIG Fuel	1.9	1.7	1.4	0.9	0.3	0.2	0.2	0.2	0.2	0.6	1.2	1.8	1.
Electric Power	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Industrial	43.	43.	43.	43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
Refuse	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Solvents	8.	8.	8.	8.	8.	8.	8.	8.	8.	8.	8.	8.	8.
Total	142.1	139.4	148.8	147.8	150.4	152.3	154.9	154.9	148.8	151.6	151.8	156.6	152.0
Carbon Monoxide													
Transportation	356.8	348.8	399.8	407.8	432.8	449.8	458.8	458.8	427.8	432.8	419.8	427.8	428.
Domestic Fuel	7.6	6.9	5.5	3.2	0.8	0	0	0	0.3	2.0	4.4	7.1	3.
CIG Fuel	1.9	1.7	1.4	0.8	0.2	0	0	0	0.1	0.5	1.1	1.8	0.8
Electric Power	0.7	0.7	0.7	0.6	0.5	0.5	0.7	0.6	0.5	0.6	0.6	0.7	0.6
Industrial	160.	160.	160.	160.	160.	160.	160.	160.	160.	160.	160.	160.	160.
Refuse	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Total	530.4	521.5	570.8	575.8	597.7	613.7	622.9	622.8	592.1	599.3	589.3	600.8	595.8
Benzopyrene*													
Transportation	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Domestic Fuel	7.5	6.8	5.5	3.1	0.8	0	0	0	0.3	1.9	4.3	7.0	3.
CIG Fuel	1.9	1.7	1.4	0.8	0.2	0	0	0	0.1	0.5	1.1	1.8	0.8
Electric Power	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Industrial	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Refuse	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total	9.6	8.7	7.1	4.1	1.2	0.2	0.2	0.2	0.6	2.6	5.6	9.0	4.0*
Particulates													
Transportation	3.1	3.0	3.2	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.
Domestic Fuel	6.3	5.7	4.6	2.7	0.8	0.2	0.2	0.2	0.5	1.5	3.7	5.9	3.
CIG Fuel	1.6	1.4	1.2	0.7	0.2	0.1	0.1	0.1	0.1	0.4	0.9	1.5	0.8
Electric Power	21.	19.	19.	16.	12.	15.	16.	16.	14.	12.	19.	20.	16.
Industrial	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.
Refuse	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Total	57.6	54.7	53.6	48.3	41.9	44.3	45.3	45.3	43.6	42.9	52.6	56.4	48.4

*lbs/day

The Delaware Valley Jaycee Regional Development Council conducted a questionnaire survey to determine the subjective reaction of the general population to air pollution. About 5,000 questionnaires were distributed to a "representative" cross section of the population throughout the Delaware Valley. Interested persons were asked to record their observations of detectable pollutants that may be causing annoyance, property damage, or irritation. A total of 254 complaints were reported on questionnaire forms returned within the three months of this survey. A resumé of the results was made available for this report.

A. Reactive Fraction of Total Organics

There are many factors affecting the amount of photochemically reactive substances released from vehicular exhausts. Among these are the type of engine, mechanical condition of the engine, type of driving cycle and composition of the fuel used. The substances in exhaust emissions that would be expected to be most reactive are the olefins and other unsaturated compounds. Data presented by Rose(2) indicate in one series of tests, that mono-olefins ranged from 14% to 72% of the weight of hydrocarbons recovered from auto exhausts. Results for diolefins ranged from 1 to 10%, and for aromatics, the range was from 2 to 36%. Totals for these three chemical groups could be expected to range from 17% to more than 95% of the total organics in vehicular exhaust emissions. Additional vapors are emitted from the carburetor, gas tank and crankcase. An estimate for a "weighted average" driving cycle in a metropolitan area would place the reactive portion at about 70% of the total organics(3).

Data regarding the precise analyses of organic emissions from fuel burning processes are limited. As with automotive emissions, there are a variety of factors that can influence the photochemically reactive nature of the organic emissions. The following approximations were made in order to estimate the reactive fraction of the total organic emissions; for coal burning, 100% of the aldehydes, 50% of the organic acids and 40% of the hydrocarbons are considered reactive; for fuel oil burning, 100% of the aldehydes, 50% of the organic acid and 50% of the hydrocarbons; for the burning of gaseous fuels, 100% of the aldehydes, 50% of the organic acids and 60% of the hydrocarbons are considered reactive. Based upon these estimates and the analyses of fuel usage in the source categories considered in the report, the percent of total organic emissions that are photochemically reactive was calculated for each fuel burning source. The results of these calculations are presented in Table H-12.

For the process of refuse incineration, it was estimated that approximately 100% of the aldehydes, 50% of the hydrocarbons and 50% of the organic acids are reactive. This indicates that about 60% of the organic emissions are photochemically reactive.

The Philadelphia Paint, Varnish and Lacquer Association reported that the reactive nature of surface coating solvents is presently being undertaken. It was estimated by that group that of the 90 tons of surface coating solvents released to the air each day, about 40 tons are photochemically reactive(4). Solvent evaporation from dry cleaning operations were conveniently classified as chlorinated and non-chlorinated types. It was estimated that about 90 percent of the chlorinated hydrocarbons and 50% of the remaining vapors are photochemically reactive, or about 20 of the 29 tons emitted per day.

The results of these calculations for each of the source categories are presented in Table H-12. This approximate analysis indicated that about 60% of the total organics emitted are photochemically reactive. It is interesting to note that in a previous survey conducted in the San Francisco Bay Area, the total organic emissions were subdivided into "very reactive", "slightly reactive" and "unreactive" portions. The "very" and "slightly" reactive fractions added up to about 60 percent of the total emissions, (1260 tons of the 2100 total tons per day)(5). There was no attempt to specify the relative degree of reactivity of the organic emissions in the Delaware Valley.

B. Particle Size Distribution

Vehicular exhaust emissions contain a large number of extremely small diameter particles. Although about 70% by count are less than one micron, this fraction represents less than 5% of the total weight of particulates emitted(2). Both the amount of particulates emitted and their size range are dependent on the mechanical condition of the engine, the driving cycle, and other factors. The fraction of particulates that are 2 microns and less in diameter would be expected to range between 10 and 80 percent by weight of the total particulates emitted from autos. Other transportation sources would exhibit similar, wide distribution. An estimated average of 50 percent less than 2 microns was used to calculate the emission of these particulates from transportation sources.

There have been very few estimates made of the size distribution of particulates emitted from residential fuel burning equipment. Based upon measurements of suspended smoke by Meetham, Anderson(6) estimated that particulates from hand fired coal burning furnaces release particles that are about 50 weight percent smaller than one micron. Existing domestic coal burning equipment and those units which have been in use for for several years will probably emit a considerable amount of particles not classified as smoke and therefore, they would have a larger size than these estimates indicate. Based upon several different studies, it has been reported that stoker fired furnaces emit a "typical" particle of close to 100 μ mass mean diameter and would have about 2 percent by weight less than 2 microns(7). An average of 20 percent less than 2 microns was estimated for hand fired and stoker fired equipment.

Particulates form pulverized coal burning equipment have a typical average mass mean diameter of about 20 microns and a standard geometric deviation of about 4(7). This distribution would indicate that about 5 percent of the particles would be less than 2 microns prior to collection equipment. This value would increase to about 30 percent after passing through typical collection equipment.

Particulate emissions from fuel oil combustion will vary in particle size distribution, depending upon the type of fuel, the combustion equipment and the degree of control, if any. Estimates of size distribution for particulate emissions from fuel oil combustion have been made in the Bay Area(8). In this study, it was estimated that about 50 percent of fuel oil combustion particulate emissions were less than 5 microns. A weighted average size distribution was estimated to be about 50 percent less than 2 microns for the Delaware Valley.

Table H-12

Subdivision of Total Organics and Particulate Emissions

Source Category	Total Organic Emissions Tons/Day	Percent Reactive	Reactive Organic Emissions Tons/Day	Total Particulate Emissions Tons/Day	Percent less than 2 microns	Particulate Emissions <2 microns Tons/Day
Transportation	1318	70	923	47	50	24
Domestic Fuel Combustion	64	50	32	53	40	21
Commercial, Governmental and Institutional Sources	18	50	9	14	40	6
Electrical Power Generation	4	40	2	99	30	30
Processing Industries	685	50	343	402	35	141
Refuse Incineration	58	60	35	43	20	9
Solvent Evaporation	118	50	59	0	0	0
Totals*	2265	60*	1403	658	35*	231

*Rounded

Particulate emissions from the combustion of gaseous fuels were assumed to be 100 percent in the less than 2 micron size range.

Emission test data on several municipal incinerators indicate that particle size distribution ranges from 14% to 24% by weight less than 2 microns(9). An estimate of 20% less than 2 microns was used for a weighted average of Delaware Valley refuse burning particulate emissions.

Using the above estimates and an analysis of the fuel consumption patterns for each source category, the amount of small particulate emissions was calculated. Results, presented in Table H-12, indicate that about 35 percent by weight are less than 2 microns. The Bay area survey estimated that 42 percent of the total particulates were less than 5 microns in diameter(8).

C. Geographical Distribution of Emissions

A study of vehicular travel patterns was made in 1960 for the nine county region in Pennsylvania and New Jersey, (all of the present survey region except Salem and New Castle Counties)(1). For purposes of data collection, during that study, the 9 county region was divided into a "cordon area", (see Figure H-1). A comprehensive vehicle survey resulted in information on traffic counts, total trips, length of travel, etc. In addition, general regional development statistics were gathered regarding land use trends, etc.

An analyses of vehicle trip density as presented in the P-J report shows that the areas of greatest vehicle density are located near the center city areas of Philadelphia, Camden and Trenton. Trip density declines proportionately with increasing distance from these areas.

Daily vehicular travel within the cordon area is estimated as about 33 million vehicle miles, over the road(1). The private auto accounts for about 86.3% of this total, trucks for about 12.9% and taxicabs for about 0.9%. If it is assumed that the average gasoline usage is 0.1 gallon per mile per vehicle and that all vehicles except one fourth of the trucks have gasoline engines, then the daily gasoline consumption in the cordon area could be calculated as:

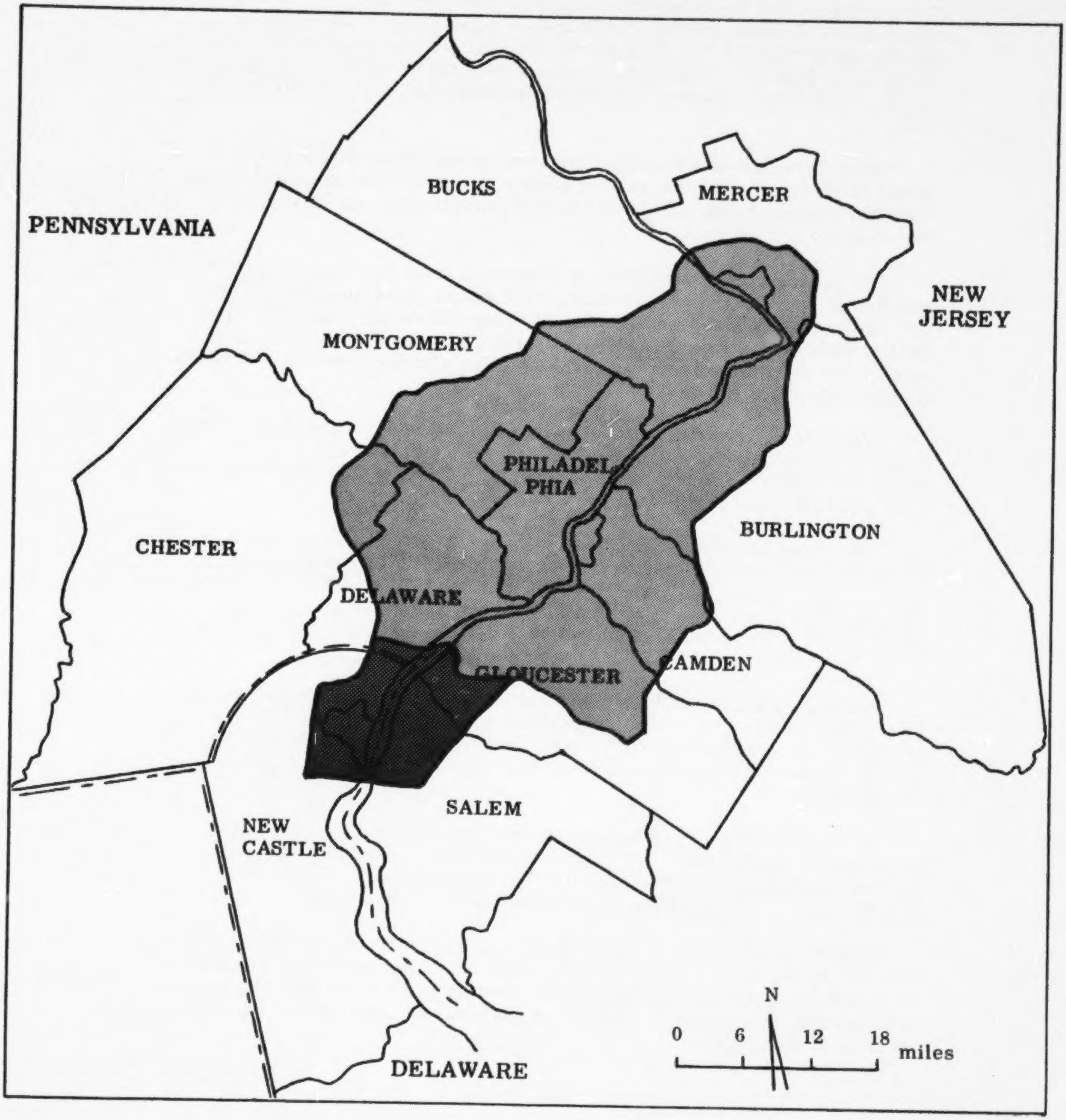
33×10^6 miles x 0.97 gasoline powered vehicles x 0.1 gallons per mile/vehicle = 3.2×10^6 gallons per day.

For the 9 counties of which the cordon area is a segment, total gasoline consumption is estimated as 3.8×10^6 gallons per day, (See Appendix A). Therefore, the percent of this gallonage consumed in the cordon area is: $3.2/3.8 \times 100 = 84\%$. These figures indicate that approximately 84% of the total emissions from vehicles in the 9 counties occurred within the cordon area.

To apply these results to the 11 county region, an estimate was made of the boundaries of a similar cordon in the Salem - New Castle County area. An expanded "cordon area" for the region is shown in Figure H-1.

Figure H-1

The Delaware Valley Survey Region



Showing original cordon (Reference 1) and expanded area.

▨ Original cordon.
■ Expanded area.

The geographical area within the cordon is about 1210 square miles, or about 27% of the total regional area of 4500 square miles. It is assumed that the same ratio of vehicular travel exists in the expanded zone, indicating that about 84% of the total 11 county vehicular emissions occur within a land area (expanded cordon) comprising only 27% of the regional area.

Since there are data available for land use and development patterns within the original cordon area, the estimates of pollution emission density for other sources being considered in this present study are based upon the expanded cordon area.

The geographical distribution of emissions from fuel consumption in residential sources and commercial, institutional, governmental sources will follow closely the distribution of dwelling unit density and population density patterns. From the patterns described in the P-J study it would appear that about 85 percent of the fuel burning activity from these sources occurs within the cordon area.

Figure H-2 shows the location of the major electrical power generating plants in relation to the expanded cordon area. The 14 plants located within the area are found to release about 97 percent of the total emissions from the 19 plants in this category.

The manufacturing and processing industries are somewhat more diversely located throughout the region, with slightly less dependence upon river basin location than the power stations. It is evident, however, from location maps for major industry sources and from land use map that at least 80 percent of the emissions from this source category occur within the cordon area.

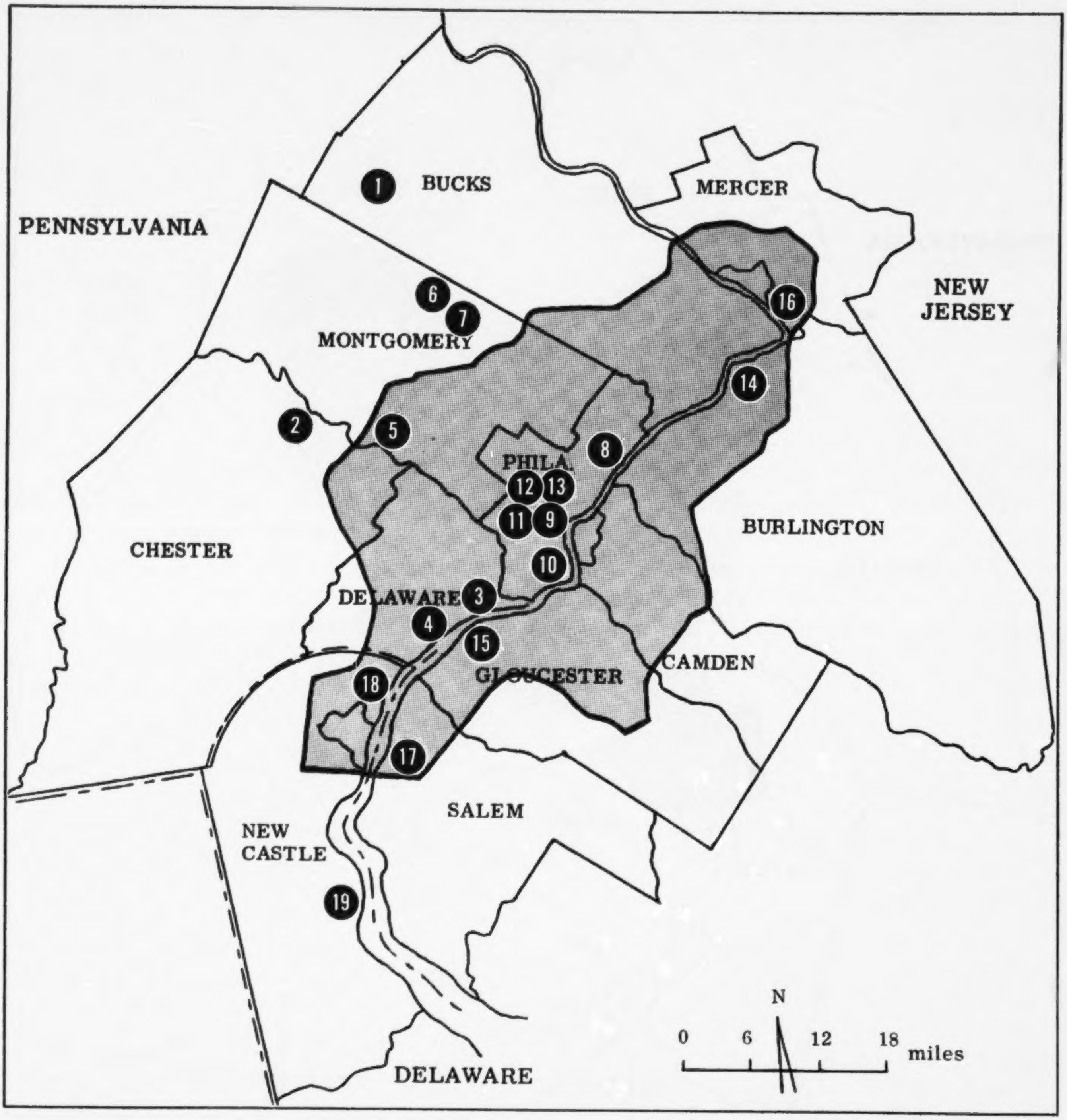
All of the major municipal incinerators are located within the cordon area (Figure H-3). The remaining refuse burning activities will be distributed in accordance with land usage. It is estimated that at least 90 percent of the total emissions from refuse incineration occur within the cordon area.

The distribution of population and dwelling unit density will roughly approximate the distribution of solvent vapor emissions from painting, surface coating and dry cleaning sources. Therefore, it is estimated that 85 percent of the total is released within the cordon area.

A summary of the calculated emissions from each source category with the cordon is presented in Table H-13. It is interesting to note that the emission density within the cordon amounts to about 11 tons per square mile per day as compared to about 0.8 tons/sq. mi. per day for the remainder of the region.

Figure H-2

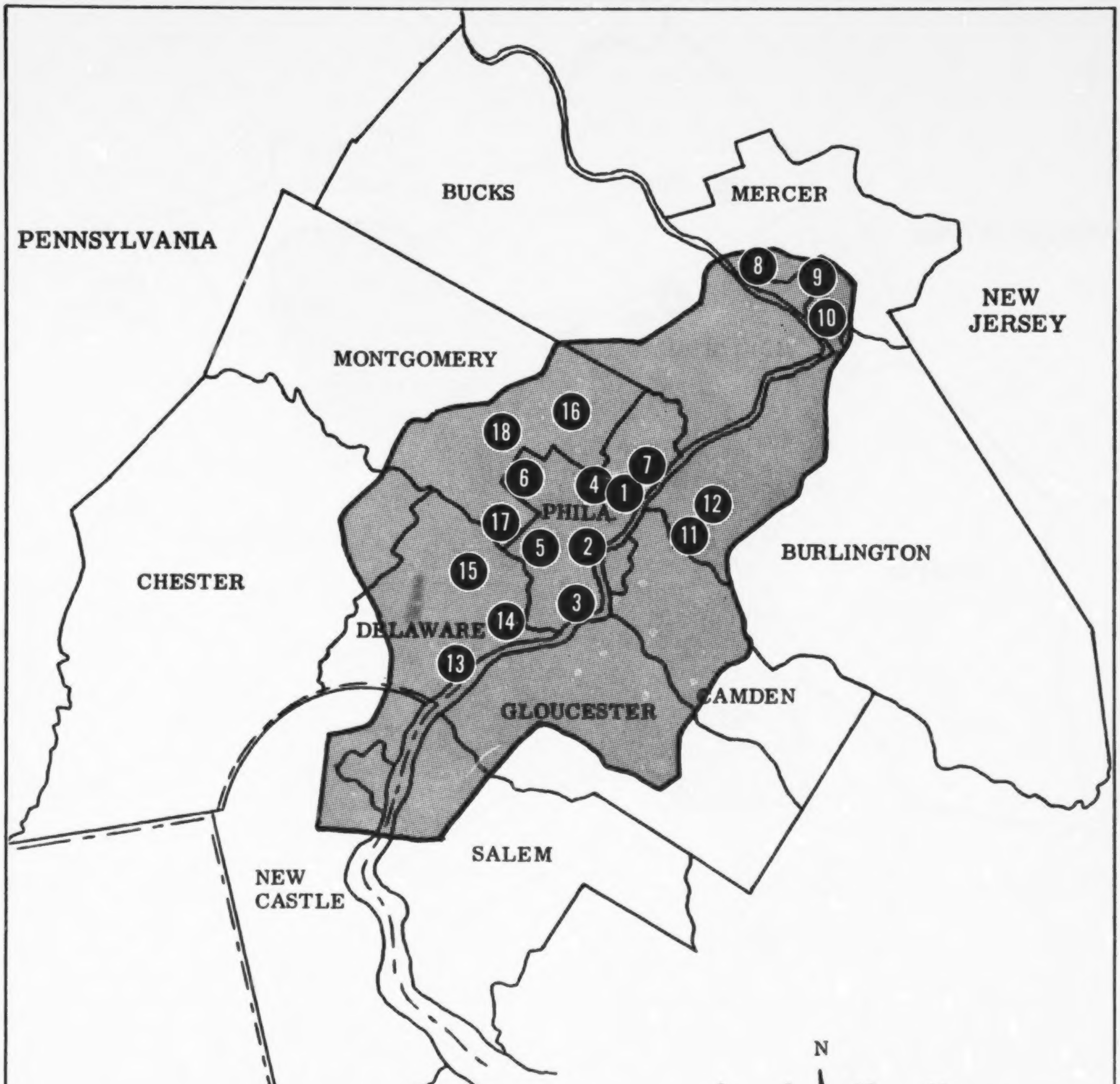
Location of Electric Power Generating Stations
In The Delaware Valley - 1965



▨ Cordon Area

Figure H-3

Major Refuse Incinerators
In The Delaware Valley - 1965



▨ Cordon Area

Table H-13

Subdivision of Emissions into Cordon Area

Source Category	Total Pollutant Emissions Tons/Day	Percent Within Cordon	Pollutant Emissions Within Cordon Tons/Day
Transportation	7,722	84	6,486
Domestic Fuel Combustion	394	85	335
Commercial, Governmental and Institutional Sources	146	85	124
Electrical Power Generation	1,638	97	1,589
Processing Industries	4,996	80	3,997
Refuse Incineration	162	90	146
Solvent Evaporation	118	85	100
Totals	15,175	85	12,777

D. Air Pollution Complaint Survey

The summary of results made available by the Regional Jaycee Development Council are presented in Table H-14.

As would be expected, the complaint frequency parallels the emission density pattern. There were 193 complaints directed toward 88 different point sources of emission. These point sources ranged from specific industrial fuel burning and processing plants to governmental and residential fuel burning sources. Complaints regarding smoke, soot and odor were most common. There were 61 complaints about "general" sources of pollution. The most common among these were smoke and odor from autos, buses and trucks on major highways and congested downtown streets.

Domestic heaters, trash and leaf burning were frequently listed. Out of all replies, there were only 20 persons that felt air pollution problems in their county could be caused by sources outside their county limits. This is perhaps a reflection of the layperson's definition of air pollution as being synonymous with "detectable nuisance."

Table H-14

Summary of Air Pollution Complaint Survey*

County	Number of Complaints	Percent of Total Complaints
Bucks	11	4
Chester	1	1
Delaware	52	20
Montgomery	56	22
Philadelphia	106	42
Burlington	5	2
Camden	11	4
Gloucester	0	0
Mercer	4	2
Salem	2	1
Newcastle	6	2
Total	254	100

*Delaware Valley Regional Jaycee Development Council
2210 Two Penn Center Plaza, Philadelphia, Pennsylvania

REFERENCES - APPENDIX H

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(4) See Appendix G.

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BUCKS COUNTY, PA./BUCKS COUNTY · BRISTOL BOROUGH · BRISTOL TOWNSHIP · FALLS TOWNSHIP · LOWER MAKEFIELD TOWNSHIP · MIDDLETOWN TOWNSHIP · MORRISVILLE BOROUGH · NEW HOPE BOROUGH · SOLEBURY TOWNSHIP/BURLINGTON COUNTY, N. J./BORDENTOWN TOWNSHIP · MOORESTOWN TOWNSHIP · RIVERSIDE TOWNSHIP/CAMDEN COUNTY, N. J./CAMDEN COUNTY · CITY OF CAMDEN · CHERRY HILL TOWNSHIP · LINDENWOLD BOROUGH · MERCHANTVILLE BOROUGH · PINE HILL BOROUGH · STRATFORD BOROUGH/CHESTER COUNTY, PA./CHESTER COUNTY · EASTTOWN TOWNSHIP · EAST WHITELAND TOWNSHIP · KENNETT SQUARE BOROUGH · UPPER UWCHLAN TOWNSHIP · UWCHLAN TOWNSHIP · WEST CHESTER BOROUGH · WEST GOSHEN TOWNSHIP/DELAWARE COUNTY, PA./BROOKHAVEN BOROUGH · CITY OF CHESTER · CHESTER HEIGHTS BOROUGH · COLWYN BOROUGH · DARBY TOWNSHIP · LANSDOWNE BOROUGH · MARPLE TOWNSHIP · SPRINGFIELD TOWNSHIP · TRAINER BOROUGH/GLOUCESTER COUNTY, N. J./LOGAN TOWNSHIP · PAULSBORO BOROUGH · WEST DEPTFORD TOWNSHIP · WOODBURY HEIGHTS BOROUGH/MERCER COUNTY, N. J./MERCER COUNTY · HIGHTSTOWN BOROUGH · PENNINGTON BOROUGH · PRINCETON TOWNSHIP · TRENTON, CITY OF · WEST WINDSOR TOWNSHIP/MONTGOMERY COUNTY, PA./MONTGOMERY COUNTY · ABINGTON TOWNSHIP · COLLEGEVILLE BOROUGH · EAST NORRITON TOWNSHIP · LOWER GWYNEDD TOWNSHIP · LOWER MERION TOWNSHIP · LOWER MORELAND TOWNSHIP · MONTGOMERY TOWNSHIP · PLYMOUTH TOWNSHIP · SPRINGFIELD TOWNSHIP · UPPER GWYNEDD TOWNSHIP · UPPER MERION TOWNSHIP · UPPER MORELAND TOWNSHIP · WEST NORRITON TOWNSHIP · WHITEMARSH TOWNSHIP/NEW CASTLE COUNTY, DELAWARE AND THE FOLLOWING CITIES AND TOWNS/MIDDLETOWN · NEWARK · NEW CASTLE · NEW CASTLE CO., DEL. · WILMINGTON, CITY OF/PHILADELPHIA CITY & COUNTY, PA./PHILADELPHIA, PA./SALEM COUNTY, N. J./SALEM COUNTY ·